NAVSHIPS 91592

INSTRUCTION BOOK

for

FREQUENCY METER TS-186D/UP

TELERAD MANUFACTURING CORPORATION
1440 BROADWAY NEW YORK 18, N. Y.

FEDERAL MANUFACTURING AND ENGINEERING CORP.
BROOKLYN 5, N. Y.

HUGH H. EBY CO., INC.
PHILADELPHIA 44, PA.

BUREAU OF SHIPS NAVY DEPARTMENT

UNCLASSIFIED

TEMPORARY CORRECTION T-5 INSTRUCTION BOOK FOR FREQUENCY METER TS-186D/UP

NAVSHIPS 91592

Section #1 - Paragraph 3 Table 1-1 change Navy type designation of the Transit Case from CY556A/Up to CY-1449/UP.

Section #2 - Paragraph 2 Page 2-2 under the heading of "Tuning", change the words on the second line from "silverplated" to "goldplated".

Section #2 - Paragraph 2 Page 2-3 on the fourth line under figures 2-3, change "waveguide E-106" to read "waveguide E-108". (Also sixth line.)

Section #2 - Paragraph 3 Page 2-4 under heading "Adjustable Concentric Lines" next to last line, change "goldplated" to read "silverplated".

Section #2 - Paragraph 3 Page 2-4 under heading "Tuning", third line, change "silverplated" to read "goldplated".

Section #4 - Paragraph 3 Page 4-3 under "Meter M-101 Reading" the last line "6 to .95" to read ".6 to .95".

Section #5 - Paragraph 4 Page 5-5 under "Capacitor Replacement (C-131)" second line change "C-123C" to read "C-123".

Section #5 - Paragraph 4 Page 5-4 Figure 5-3 Waveguide Tuner Remover Omit H-108 not required.

Section #6 - Page 6-4 Symbol (C-110) change from "50mmfd - 10%" to read "500 mmfd - 10%".

Section #6 - Page 6-9 Symbol (H-108) Omit Spanner wrench not required.

Section #6 - Page 6-10 Symbol (J-102) Connector, receptacle, change to read "three male contacts straight type, 1.420"lg, 1.680" diam, 1.920" lg mtg flange, .250 volt 10 amps. 125 volt 15 amps cylindrical metal shell, black bakelite insert two .245" diam. mtg holes 2.120" c/c".

Section #6 - Page 6-14 Symbol (P-101) Connector, plug, change to read "three female cont; straight type; 1.525" diam x 1.880" h o/a excluding cable clamp; cont rated 10 amp at 250 V; 15 amp at 125 V; cylindrical steel body; cad. pl. composition insert; opening for o.562" diam cable; has cable clamp in top.

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PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	Original	5–0 to 5–20	Original
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3–0 to 3–2	Original		
4–1 to 4–5	Original		

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code 993-100
16 January 1952

From: Chief, Bureau of Ships
To: All Activities Concerned with the Installation, Operation and Maintenance of the Subject Equipment

Subj: Instruction Book for Frequency Meter TS-186D/UP NAVSHIPS 91592

1. This is the instruction book for the subject equipment and is in effect upon receipt.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense Publications.

4. All Navy requests for NAVSHIPS Electronics publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the BuShips ELECTRON and in the Index of Bureau of Ships General and Electronics Publications, NAVSHIPS 250-020.

H. N. WALLIN
Chief of Bureau

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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GUARANTEE

The equipment, including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such items found to be defective as to material, workmanship or manufacture will be repaired or replaced f.o.b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government; provided that such guarantee will not obligate the Contractor to make repair or replacement of any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and the defect is not the result of normal expected shelf life deterioration.

To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten percent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred percent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expedious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for affecting expedious adjustment under the provisions of this contractual guarantee.

The above one-year period will not include any portion of time the equipment fails to perform satisfactorily due to any such defects, and any items repaired or replaced by the Contractor will be guaranteed anew under this provision.

INSTALLATION RECORD

Contract Number NObsr—52270 Date of Contract, 23 February 1951

Contract Number NObsr—71156 Date of Contract, 9 December 1957

Serial Number of Equipment.....

Date of Acceptance by the Navy.....

Date of delivery to contract destination.....

Date of completion of installation.....

Date placed in service.....

Blank spaces on this page shall be filled in at time of installation.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS (383) revised. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the Bureau of Ships Manual or superseding instructions.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Federal stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the Bureau of Ships Manual or superseding instructions on the subject of radio-safety precautions to be observed. This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment. While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

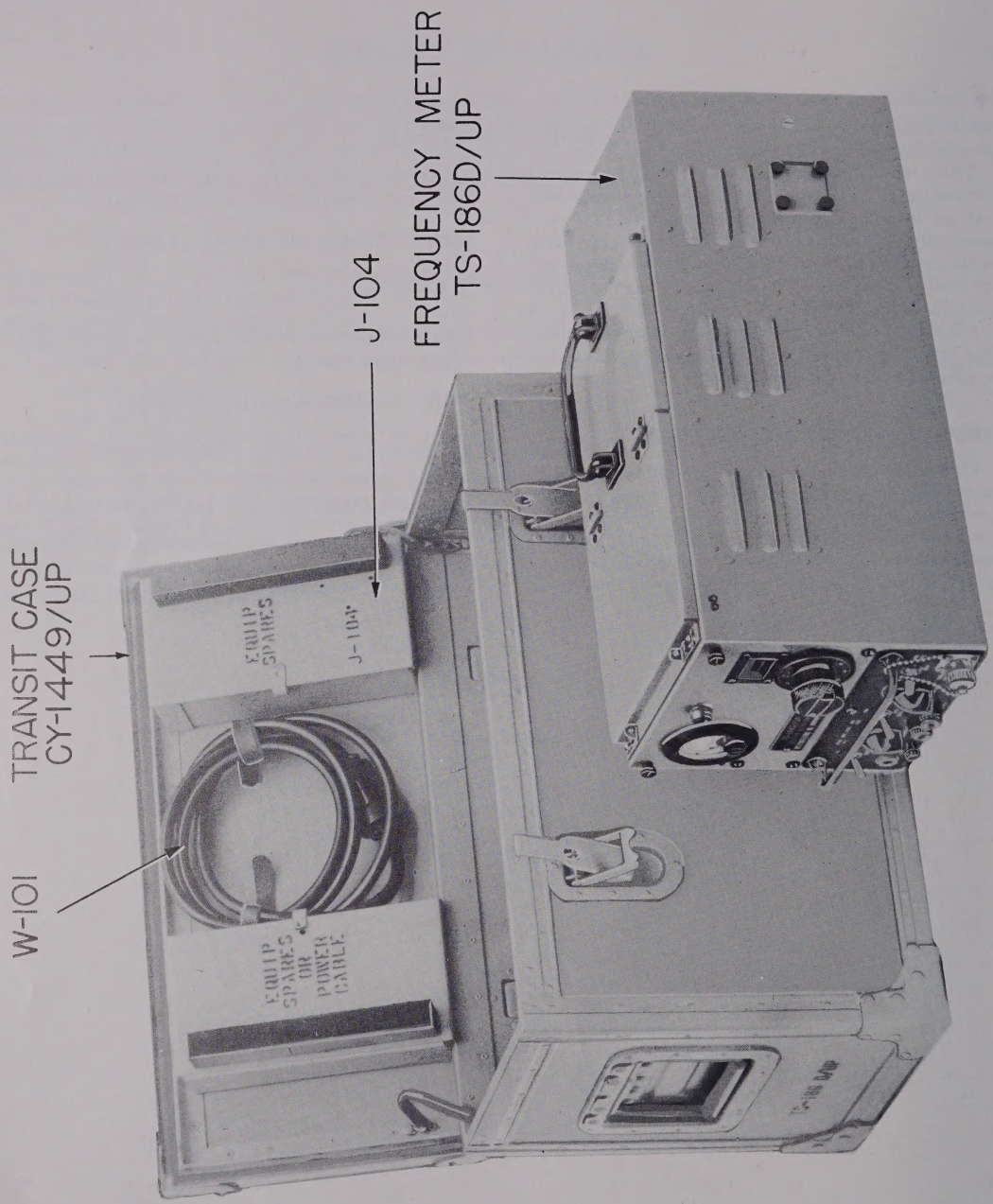

Figure 1-1. Complete Equipment, Frequency Meter TS-186D/UP

SECTION 1
GENERAL DESCRIPTION

1. PURPOSE.

This instruction book is for use only with Frequency Meter TS–186D/UP and provides information on the theory of operation, proper method of adjustment, operation and maintenance of the equipment.

2. DESCRIPTION.

a. RANGE.—Frequency Meter TS–186D/UP is de signed for making frequency measurements in the range of 100 to 10,000 megacycles. Harmonics of the unknown signal or of the heterodyne oscillator are used for measurements outside of the 500 to 1250 mc fundamental range of the heterodyne oscillator.

b. ELEMENTS.—The equipment consists of six elements, Heterodyne Oscillator, Crystal Calibrator, Detector-Mixer, Audio Amplifier, Beat Indicator and Power Supply. These elements are contained on a metal chassis with their necessary controls, switches and a meter mounted on the front panel.

c. CALIBRATION.—Crystal calibrator check points are provided every five megacycles in the 500 to 1250 mc range of the heterodyne oscillator. The heterodyne oscillator dial reading for each five mc crystal check point is recorded in an individual calibration book attached to each unit under a hinged cover on the top surface of the case. Additional interpolation points are also recorded, giving a total of 750 entries distributed over approximately 16,500 dial divisions representing the tuning range of the heterodyne oscillator.

d. HOUSING.—The complete assembly is housed in a metal case and fastened in place by four captive thumb screws. Louvres, protected by fine mesh wire screen, are provided for ventilation in the case. Power connections are made at the rear of the unit.

3. REFERENCE DATA.

a. Nomenclature: Frequency Meter TS–186D/UP.

b. Contract NObsr–57596 dated 30 June 1952.

c. Contractor: Telerad Manufacturing Corporation, 1440 Broadway, New York 18, N. Y. Manufactured at Flemington, New Jersey, plant.

d. Cognizant Naval Inspector: Inspector of Naval Material, Newark, New Jersey.

e. Number of Packages Involved per Complete Shipment: one package.

f. Total cubical contents, crated and uncrated: see Table 1–1.

g. Total weights, crated and uncrated: see Table 1–1.

h. Frequency range measured: 100 to 10,000 mcs.

i. Characteristics of Elements:

(1) HETERODYNE OSCILLATOR.—Continuous frequency range 500 to 1250 megacycles.

(2) CRYSTAL CALIBRATOR.—20 mc output controlled by 5000 kc quartz crystal.

(3) DETECTOR-MIXER.—For mixing and beating the output of the heterodyne oscillator with either the crystal calibrator or the signal being measured.

(4) AUDIO AMPLIFIER.—To amplify the resulting beat frequency detector output in the range of 100 to 100,000 cps.

(5) BEAT INDICATOR.—To provide a visual indication of the presence of a beat, the frequency of which is in the range of 100 to 100,000 cps.

(6) POWER SUPPLY.—To supply heater and 300 volts DC (regulated) plate supply for the equipment. This supply operates from 115 volts ±10% source, single phase, 50-1000 cycles. Total power consumption is approximately 70 watts.

j. ACCURACY.—The overall accuracy of frequency measurements when using this equipment under fixed conditions of temperature, humidity, and pressure, but anywhere within the following ranges, is 0.01 percent or better. The 0.01 percent accuracy is premised upon measurements which are made within five minutes after the heterodyne oscillator has been checked in terms of the crystal calibrator, and made after a 20 minute equipment warm-up period at a ***constant*** ambient temperature. Crystal calibrator check points are accurate to 0.002 percent.

(1) Temperature Range: —40 to 55°C (—40 to 131°F).

(2) Humidity Range: 0 to 95 percent relative at temperatures up to 50°C (122°F).

(3) Pressure Range: from atmospheric down to a pressure corresponding to an altitude of 10,000 feet.

k. SENSITIVITY. — The equipment will function efficiently for RF signal input levels between 500 microvolts and one volt.

l. Equipment Supplied:

TABLE 1–1. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	OVERALL DIMENSIONS (INCHES)						VOLUME (CU. FT.)		WEIGHT (LBS.)	
			CRATED*			UNCRATED						
			Height	Width	Depth	Height	Width	Depth	Crated*	Uncrated	Crated*	Uncrated
1	Frequency Meter	TS–186D/UP	—	—	—	9½	8½	20	—	.94	—	42.5
1	Coaxial Adapter		—	—	—	1⅝	1⅝	$2\frac{7}{16}$	—	—	—	3 oz
1	Power Cable	CWI–62412(7')	—	—	—	—	—	—	—	—	—	.8
2	Instruction Books	NAVSHIPS 91592	—	—	—	—	—	—	—	—	—	1.5
1	Transit Case	CY–556A/UP	18½	18½	34¼	13	11½	23	6.8	2.0	97	22

* Crated dimensions, volume and weight of the transit case includes the values for the Frequency Meter and accessories.

m. EQUIPMENT REQUIRED BUT NOT SUPPLIED.—One pair of headphones with an impedance of 600 ohms or higher terminated in a two conductor telephone plug. These headphones may be Army-Navy type H–1/AR, H–4/AR or Navy type 49016 with a Navy type 49006 plug.

n. EQUIPMENT SIMILARITIES.—Frequency Meter TS–186D/UP performs the same functions as the Frequency Meters TS–186C/UP, TS–186B/UP, TS–186A–UP and TS–186/UP. Frequency meter TS–186D/UP utilizes a detector-mixer type 12AT7 tube instead of a type 2C51 tube, due to the unavailability of the type 2C51 tube.

These equipments are fundamentally identical except for the differences listed in Table 1-2.

o. Electron Tube Complement:

Tube Type	*Number Used*
2C40	1
12AT7	1
5Y3GT/G	1
6SJ7	4
6SN7GT	1
OD3/VR–150	2

TABLE 1-2. BASIC DIFFERENCES BETWEEN TS-186/UP SERIES EQUIPMENT

EQUIPMENT	FUSES	ELECTRON TUBE DIFFERENCES	POWER TRANSFORMER	DC FILAMENTS
TS–186D/UP	Two line fuses located before line filter	Detector-mixer Type 12AT7	Continuous operation 115 VAC ±10%	1st Audio and detector-mixer 6.3 VDC. All others 6.3 VAC
TS–186C/UP	Two line fuses located before line filter	Detector-mixer Type 2C51	Continuous operation 115 VAC ±10%	1st Audio and detector-mixer 6.3 VDC. All others 6.3 VAC
TS–186B/UP	Two line fuses located before line filter	Detector-mixer Type 2C51	Variable tap for 105, 115, and 125 VAC	1st Audio and detector-mixer 6.3 VDC. All others 6.3 VAC
TS–186A/UP	Single line fuse located after line filter	Detector-mixer Type 2C51	Variable tap for 105, 115, and 125 VAC	Detector-mixer 6.3 VDC. All others 6.3 VAC
TS–186/UP	Single fuse located after line filter	Detector-mixer Type 955	Variable tap for 105, 115, and 125 VAC	Detector-mixer 6.3 VDC. All others 6.3 VAC

SECTION 2

THEORY OF OPERATION

1. GENERAL DESCRIPTION.

a. The electrical circuit consists of five basic units as shown in the following diagram. For complete schematic see Fig. 5–10.

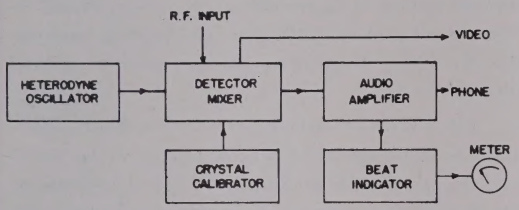

Figure 2–1. Block Diagram of Basic Circuit Elements

b. The frequency of an unknown signal is measured by obtaining an audible beat between this signal or one of its harmonics and the signal generated in the HETERODYNE OSCILLATOR or one of its harmonics. The HETERODYNE OSCILLATOR is a calibrated variable frequency source, the fundamental frequency of which covers the range from 500 to 1250 megacycles.

c. The unknown and the locally generated signals are mixed in the DETECTOR-MIXER and the resulting beat may be observed in three ways:

(1) The audible beat note is amplified in the AUDIO AMPLIFIER and may be heard in the headphones.

(2) A BEAT INDICATOR coupled to the AUDIO AMPLIFIER will indicate the presence of beat frequencies from 100 cycles to 100,000 cycles.

(3) VIDEO output receptacle (J–101) provides a 600 ohm output of the DETECTOR-MIXER for visual observation of beat frequencies.

d. For precise measurements, the calibration of the HETERODYNE OSCILLATOR can be checked in five-megacycle steps against the CRYSTAL CALIBRATOR.

2. ELECTRICAL DESCRIPTION.

a. HETERODYNE OSCILLATOR.

(1) CIRCUIT.—A special triode electron tube designed for ultrahigh frequency oscillation is used in this circuit. Two concentric waveguide tuning elements are employed, see paragraph 3*a* (1), one in the plate-grid circuit and the other in the grid-cathode circuit of the 2C40 oscillator tube V–107. The design is so arranged that the electron tube plugs into the concentric line tuner circuits making the plate, grid, and cathode elements integral with the lines themselves.

(a) PLATE CONNECTION.—The three silver-plated metal tubes forming the tuner circuits are all at d. c. ground potential. The RF connection between the plate of V–107 and the inner conductor of the plate-grid tuner is made through a built-in silvered mica disc capacitor C–131. (See Figure 5–9). The d. c. connection to the electron tube plate is made by means of an insulated lead run inside this inner tubular conductor, and through internal resistors R–135, R–136, R–137.

(b) GRID CONNECTION.—The grid element of V-107 is connected directly to the outer tube of the plate-grid tuner. This circuit is sometimes referred to as a grounded-grid oscillator.

(c) RF CATHODE CONNECTION.—The silver-plated shell of V–107 is connected directly to the housing. The d. c. cathode is by-passed to this shell inside the electron tube by means of a silvered mica disc capacitor.

(d) The d. c. cathode and heater leads are brought out in the normal manner to pins in the octal base of V–107.

(2) TUNING.—The frequency of the heterodyne oscillator is varied by sliding two silver-plated short-circuiting contact rings simultaneously inside the concentric tuners. These are controlled directly by the tuning dial on the front panel as described in paragraph 3*a* (1) *(a)*. This varies the electrical length of the two circuits.

CAUTION

The RF FEEDBACK adjustment should not be changed under normal operating conditions. Changing the setting of this adjustment will require recalibration of the equipment.

(3) FEEDBACK.—Some additional RF feedback is required for the proper operation of the oscillator. This is provided by means of the 4-40 machine screw at the rear of the top face of the tuner housing, which projects through a hole in the center conductor into the plate-grid tuner space, providing the necessary inter-coupling. (See figure 5–9.)

(4) RF OUTPUT.—RF coupling to the detector-mixer V–103 is provided by means of a short probe which projects through the outer tank conductor into the grid-cathode tuner circuit providing ELECTROSTATIC COUPLING.

(5) D. C. CATHODE AND HEATER RF FILTER.—The V-107 cathode and heater leads are filtered by means of capacitors C–132, C–133, and C–134 mounted inside the metal shell containing socket X–107 for electron tube V–107. (See figure 5–9).

(6) SWITCHING.—The 6.3 volt heater of oscillator electron tube V–107 is on continuously when the power switch S–102 is ON. The plate voltage can be switched ON or OFF by means of HET. OSC. switch S–103 on the front panel.

b. CRYSTAL CALIBRATOR.

(1) 5000 KC CRYSTAL OSCILLATOR AND 10 MC. DOUBLER.—The RF inductor L–101 and capacitor C–103 in the cathode circuit of electron tube V–101 are resonant at a frequency considerably lower than 5000 kc. This tank circuit is therefore capacitive at the oscillating frequency. Since the screen grid (acting as the oscillator anode) is at RF ground potential (by-passed by C–104) the cathode is raised to a potential between this anode and the control grid making the conditions favorable for oscillation. This circuit arrangement provides excellent frequency stability and is rich in harmonics.

The trimmer capacitor C–101 across the crystal Y–101 is used to adjust the fundamental frequency to exactly 5000 kc., and provides for frequency readjustment when replacing oscillator tube V–101. This adjustment is described in Section 4, paragraph 1*b*(1). Energy is supplied to the plate circuit through the electron stream.

This plate circuit is tuned to the second harmonic of the oscillator by means of the parallel resonant combination of capacitor C–105 and iron core tuned inductor L–102. Since this circuit represents a high impedance to the second harmonic frequency and a relatively low impedance to others, the second harmonic voltage is impressed across resistor R–105 in the control grid of V–102 through coupling capacitor C–107. Other frequencies are by-passed to ground through C–106.

(2) TWENTY MEGACYCLE DOUBLER.—Similarly to subparagraph b(1) above, electron tube V–102 operates as a doubler producing the second harmonic of the 10 mc. signal impressed on its grid. Capacitor C–110 and iron core tuned inductor L–103 are tuned to 20 mc. which is applied to the control grid of the mixer section V–103B of the Detector-Mixer tube V-103.

(3) SWITCHING.—The 6.3 volt heaters of the crystal-calibrator electron tubes V–101 and V–102 and of the crystal unit Y–101 are on continuously when the POWER switch is *ON*. Plate voltage for these tubes may be switched ON or OFF by means of XTAL CAL. switch S–101 located on the front panel.

c. DETECTOR-MIXER. *(See Figures 2–2 and 2–3.)*

(1) CIRCUIT.—The output of the crystal calibrator 20 mc. doubler, V–102, is capacitively coupled

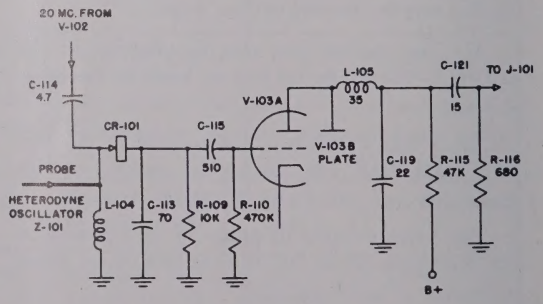

Figure 2–2. Simplified Schematic, CR–101 Detector

to one section of the electron tube detector-mixer, V–103B, operating as a detector, through capacitor C–112 and to the rectifying crystal CR–101 through capacitor C–114. Section A of V–103, connected to CR–101 with the coupling network consisting of R–109, C–115 and R–110, is used as an additional audio amplifier for the crystal output. Two detectors, CR–101 and V–103B, are used to provide efficient detection over the 100 to 10,000 mc. range. Although both detectors operate to some extent over this frequency range, CR–101 becomes more effective above 500 mc. whereas below this frequency V–103B is more efficient.

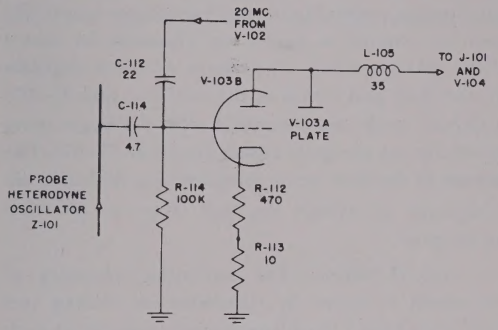

Figure 2–3. Simplified Schematic, V–103B Detector-Mixer

The output of the heterodyne oscillator tuner Z–101 is directly coupled to the crystal CR–101 by means of the detector r-f probe. This probe which passes directly through the waveguide E–106 also conducts the signal to be measured to the crystal CR–101 when the output of the signal source is connected to the waveguide E–106 by another section of waveguide, or connected to the probe through the waveguide adapter, J–104, and a coaxial cable.

The plate circuit of V–103 is connected to the Video Output jack J–101 through an r.f. filter composed of choke L–105 and capacitor C–119. This filter prevents the 20 megacycle signal from appearing in the output. The video then goes to output jack J–101 through isolating capacitor C–121 and load resistor R–116. Signals appearing in the plate circuit therefore may be observed visually if an oscilloscope is connected to J–101. This jack is a UHF connector of the non-constant impedance type and will therefore introduce some voltage reflection. However, it will be generally satisfactory up to 200 mc.

(2) MIXING.

(a) HETERODYNE OSCILLATOR WITH CRYSTAL CALIBRATOR.—Harmonics of the 20 mc. of the crystal calibrator signal are rectified in V–103B. These harmonics beat with the heterodyne oscillator frequency producing useful frequency differences which are amplified and appear in the plate circuit of V–103B. Likewise harmonics of the heterodyne oscillator frequency are produced and beat with harmonics of the 20 mc. input providing additional beats or check points.

Harmonics of the crystal calibrator will beat with the fundamental or harmonics of the heterodyne oscillator at the check point frequencies, for example, the 121st harmonic of the 20 mc. crystal calibrator output is equal to 121 x 20 or 2420 mc. which will zero beat with the 4th harmonic of the heterodyne oscillator when it is tuned to 605 mc. (605 x 4 = 2420 mc.). Additional examples are given in the following table:

CRYSTAL CALIBRATOR				CHECK POINT FREQUENCY		HETERODYNE OSCILLATOR		
Fundamental	×	Harmonic	=		=	Harmonic	×	Fundamental
20	×	25	=	500	=	1	×	500
20	×	30	=	600	=	1	×	600
20	×	121	=	2420	=	4	×	605
20	×	61	=	1220	=	2	×	610
20	×	51	=	1020	=	2	×	510

(b) HETERODYNE OSCILLATOR WITH UNKNOWN RF SIGNAL.—These two signals are mixed in the crystal rectifier CR–101 and V–103B. Therefore, beats are produced between the fundamental or harmonics of either signal and are amplified by V–103A.

1. EXAMPLE.—In measuring the frequency of a 112 megacycle signal connected to the RF INPUT of the Frequency Meter TS–186D/UP, the strongest beats would be produced by using the lowest possible harmonic of the 112 megacycle signal. This would be the fifth harmonic (560 mc), which would zero-beat with the heterodyne oscillator if the oscillator is tuned to 560 megacycles.

2. EXAMPLE.—In measuring RF signals the frequencies of which lie above the fundamental tuning range of the heterodyne oscillator, for instance 3000 megacycles, harmonics of the heterodyne oscillator are used. In this case the lowest usable harmonic of the heterodyne oscillator would be the third. With the heterodyne oscillator tuned to 1000 megacycles, its

third harmonic would produce a zero beat with a 3000 megacycle signal.

d. AUDIO AMPLIFIER.—The beat frequency output of the detector-mixer V–103 is amplified by three stages of resistance-coupled amplification using a type 6SJ7 V–104 and both sections of a type 6SN7 V–105. The output stage is cathode-coupled to the AUDIO OUTPUT jack J–102 for use with 600-ohm headphones. The output level is controlled by VOLUME control R–122.

e. BEAT INDICATOR. — This indicator consisting of electron tube V–106, switch S–104 and meter M–101 is capacitively coupled through C–125 to the plate of the second audio amplifier electron tube V–105. Bias for V–106 is developed by grid rectification of the incoming signal, and is developed across the grid resistor R–128. This causes a decrease in the cathode current depending on the strength of the signal. When the IND. SWITCH S–104 is set at BEAT IND., this decrease in cathode current may be observed as a dip in the indication on milliammeter M–101. With no signal applied, the cathode current of V–106 is adjusted by means of the screen voltage control R–130, and is normally set at 0.9 milliamperes. [See Section 5, paragraph 1*a*(2)].

The frequency response of the beat indicator is determined by the response of the detector and first audio stage. Components for these circuits are chosen to give satisfactory response from 100 to 100,000 cycles.

f. POWER SUPPLY.—A conventional type power supply is used in the TS–186D UP equipment. D. C. plate voltage is filtered by a single section capacity input filter consisting of C–139, L–108, and C–140, and is regulated by means of two OD3/VR–150 regulator tubes, V–109 and V–110, connected in series. To further improve the regulation when switching either the heterodyne oscillator or the crystal calibrator plate circuits, dummy resistance loads R–140 and R–141 are provided in the *OFF* positions of the two switches S–101 and S–103 controlling these circuits.

This supply also furnishes 6.3 v. a. c. for the crystal unit and the heaters of all electron tubes except V–103 and V–104. The heaters of these tubes are supplied with 6 v. d. c. by the selenium rectifier CR–102.

All tube heaters in the equipment are energized when the POWER switch S–102 is *ON*. Likewise, plate voltage is supplied continuously to the detector-mixer V–103 and to the amplifier system V–104, V–105 and V–106.

3. MECHANICAL DESCRIPTION.

a. HETERODYNE OSCILLATOR WAVEGUIDE TUNER ASSEMBLY, Z–101. *(See figure 5–9.)*—The complete tuner assembly is located along the top right side of the chassis with the tuning control located on the front panel. A section view of this assembly is shown in figure 5–9.

(1) ADJUSTABLE CONCENTRIC LINES.—The unit consists essentially of two waveguide circuits, the electrical lengths of which are adjustable by means of the tuning control. The smaller of the waveguides (in the plate-grid circuit of the oscillator tube V–107) is located inside and concentric with the larger outer waveguide (in the grid-cathode circuit of V–107). The surfaces of the three metal tubes forming this tuner are gold-plated to increase the high frequency electrical conductivity.

(a) TUNING.—The oscillating frequency of the system is varied by simultaneously sliding two silver-plated short-circuiting contact rings, one in each tuner, thereby varying the electrical lengths of these lines.

(2) LEAD-SCREW DRIVE MECHANISM.—The tuning dial on the front panel drives a micrometer lead screw within the assembly which causes a bronze casting to slide longitudinally along four guide rods. Back-lash between the casting and the lead screw is reduced by means of a spring-loaded nut in the casting housing. A pre-loaded precision ball bearing is used on the lead screw, and is located in the front bearing block of the tuner assembly. Two sets of push rods, each fastened at one end to the casting assembly, and at the other end to the respective contact rings within the tuners, cause these rings to move with the casting. The effective length of each set of push rods can be changed independently at the casting assembly for purposes of electrical adjustment.

(3) TUNING DIAL AND COUNTER SYSTEM. —A revolution counter is located above the tuning dial and is viewed through a small rectangular hole in the front panel. The counter is geared directly to the micrometer lead screw. The tuning dial is divided into 100 divisions. Since approximately 165 revolutions of the lead screw are necessary for the required travel of the driving mechanism, the frequency range

of the heterodyne oscillator is represented by approximately 16,500 dial divisions.

CAUTION

Except for replacement of the 2C40 electron tube V–107, due to failure, this tube should not be removed, or the mounting tampered with, as this may require complete recalibration of the equipment.

(4) OSCILLATOR ELECTRON TUBE MOUNTING. *(See figures 5–3 and 5–4.)*—The oscillator tube V–107 used in this system is of special construction for use in this type of ultra-high-frequency oscillator. The tube elements form an integral part of the concentric lines. Contact fingers are provided at the ends of the inner, central, and outer metal tubes for contacting the plate, grid, and RF cathode of the oscillator electron tube. The base end of the electron tube is plugged into an octal socket mounted within a metal shell. This assembly is in turn fastened to the rear of the tuner assembly by means of a knurled threaded ring. Filament and DC cathode connections are brought out through a grommeted hole in this shell.

SECTION 3

INSTALLATION

1. UNPACKING.

a. The transit case CY-1449/UP, containing the Frequency Meter TS–186D/UP is enclosed in a moisture-vapor-proof barrier and packed in a waterproof cardboard carton. See figure 3–1. Cut the seals on the moisture-vapor-proof barrier approximately one inch back from the edge and remove the contents. Remove all additional wrappings including desiccants.

b. Inspect the equipment for any obvious damage caused by shipping.

2. INSTALLATION.

Frequency Meter TS–186D/UP is a portable test set and does not require permanent installation. See figure 3–2 for overall dimensions.

3. INITIAL ADJUSTMENTS.

Before placing this equipment in operation, check the *Preliminary Adjustments* described in Section 4, paragraph 2.

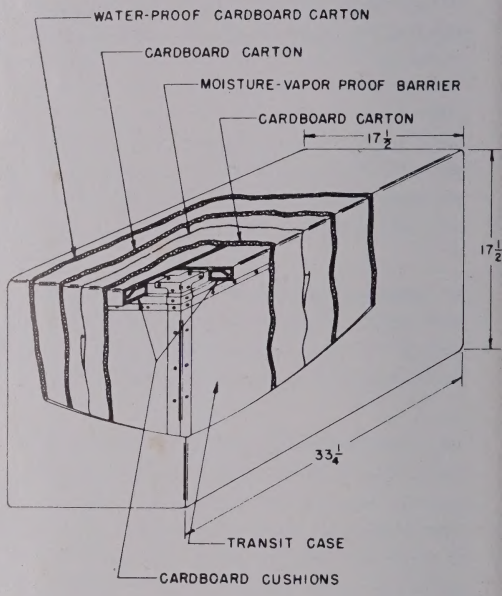

Figure 3-1. Packing, Frequency Meter TS-186D/UP

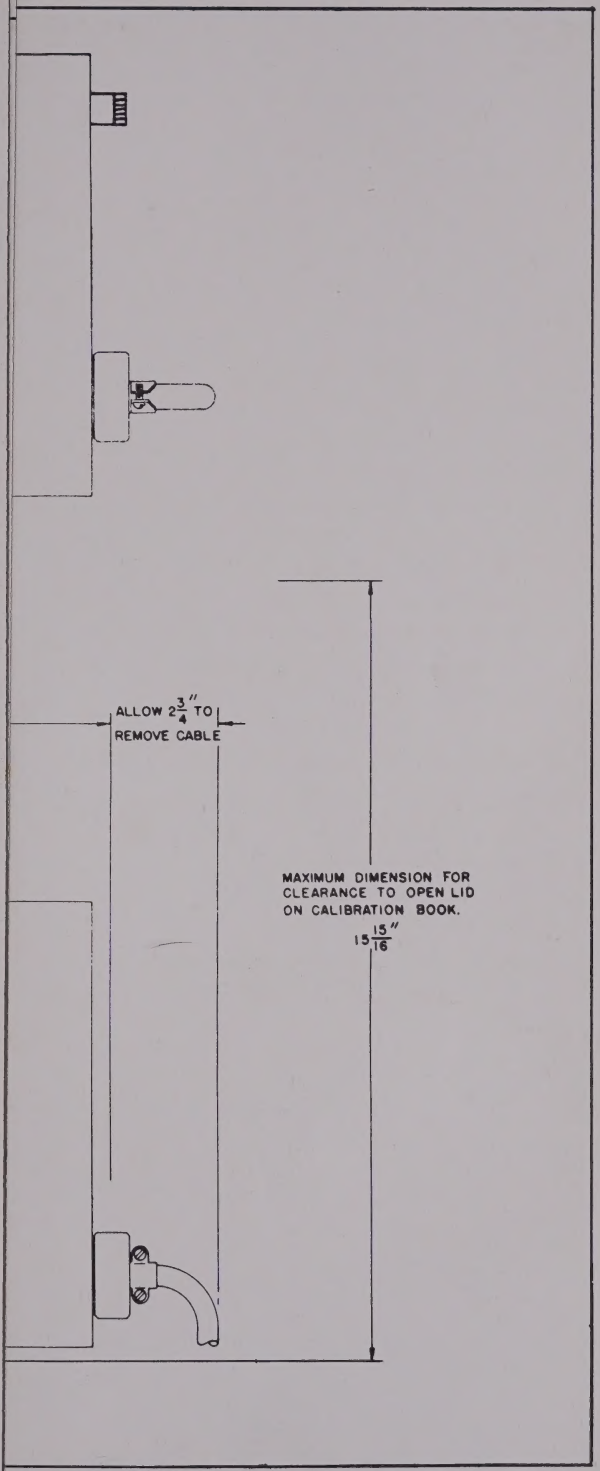

Figure 3-2. Outline Drawing, Frequency Meter TS-186D/UP

SECTION 3

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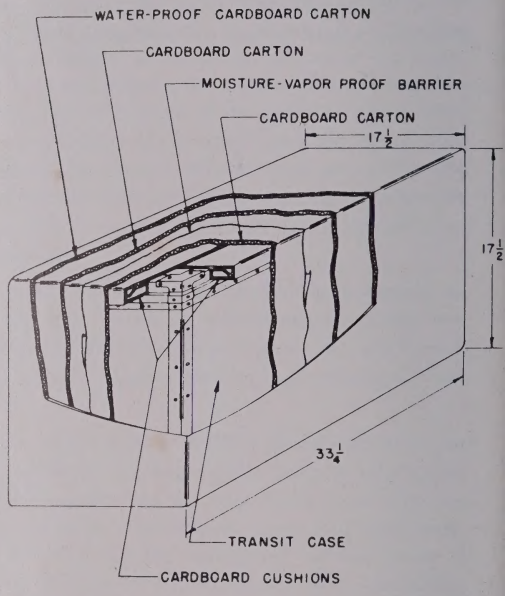


Figure 3-1. Packing, Frequency Meter TS-186D/UP

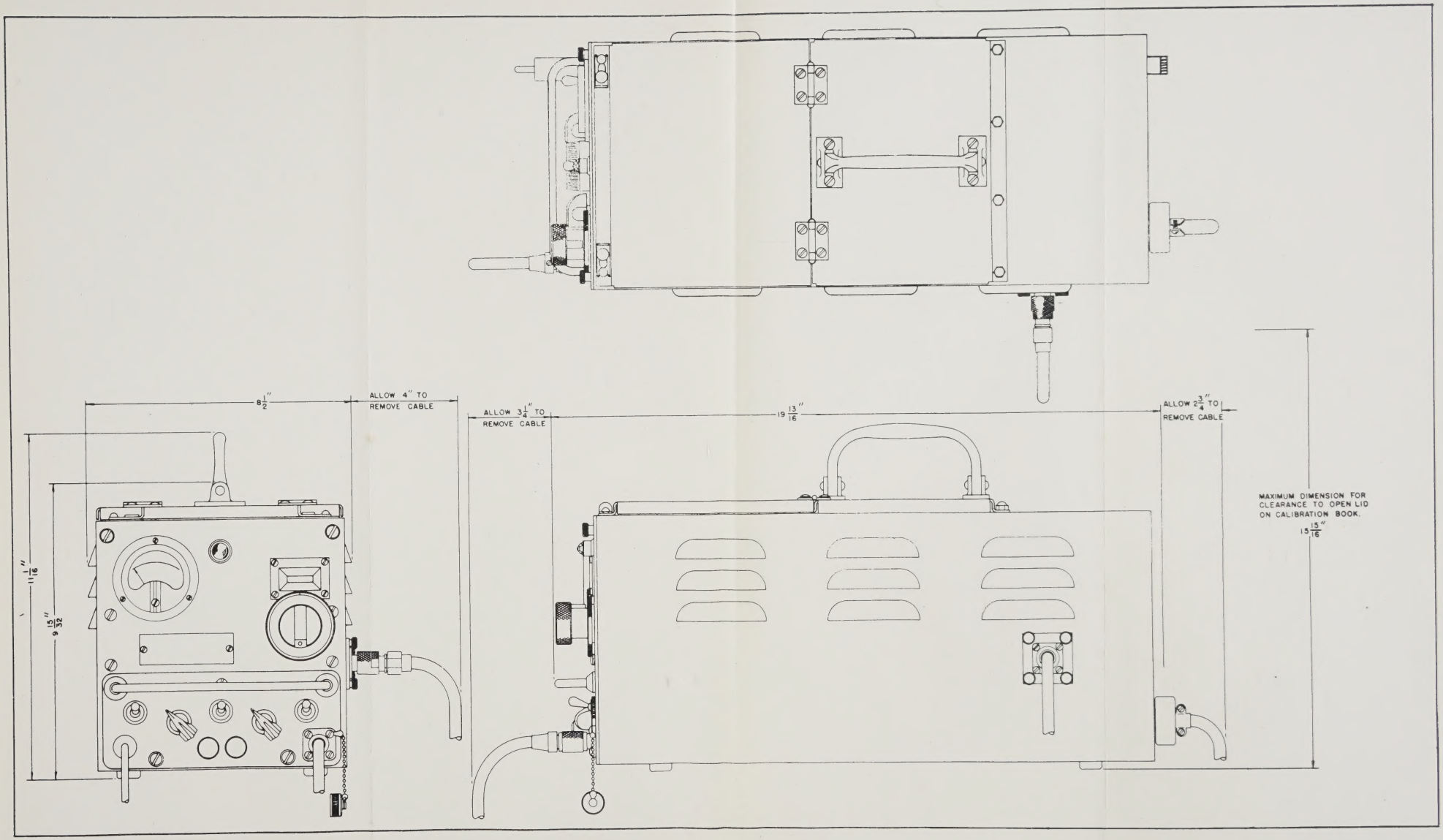

8 1/2"
ALLOW 4" TO REMOVE CABLE
ALLOW 3 1/4" TO REMOVE CABLE
19 13/16"
ALLOW 2 3/4" TO REMOVE CABLE
MAXIMUM DIMENSION FOR CLEARANCE TO OPEN LID ON CALIBRATION BOOK.
15 15/16"
11 1/16"
9 15/32"

Figure 3-2. Outline Drawing, Frequency Meter TS-186D/UP

SECTION 4
OPERATION

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Personnel must observe all safety regulations at all times.

1. FUNCTION OF PANEL CONTROLS. *(See figure 4–3.)*

a. METER M–101.—Indicates the presence of beat frequencies, measures the grid current of the crystal oscillator and the cathode currents of the detector-mixer, heterodyne oscillator and beat indicator electron tubes.

b. PILOT LAMP I–101.—Indicates that the equipment is in operation, Power Switch S–102 "ON."

c. TUNING DIAL ASSEMBLY INCLUDING COUNTER O–101.—Tunes the heterodyne oscillator.

d. "POWER" SWITCH S–102.—Applies power to the complete equipment.

e. "AUDIO OUTPUT" JACK J–102.—Headphone jack for aural reception of signals.

f. "IND SWITCH" S–104.—Switches Meter M–101 to perform functions listed in line (1) of this paragraph.

g. "XTAL CAL" SWITCH S–101.—Applies plate voltage to the crystal calibrator.

h. "FUSE, SPARE" F–103.—Spare fuse, 2 amp.

i. "FUSE, SPARE" F–104.—Spare fuse, 2 amp.

(NOTE: Operating fuses F–101 and F–102 located at rear of TS–186D/UP.)

j. "VOLUME" R–122.—Controls audio output level at J–102 and indication of M–101.

k. "HET OSC" SWITCH S–103.—Applies plate voltage to the heterodyne oscillator.

l. "VIDEO OUTPUT" JACK J–101.—UHF connector for visual observation using an external oscilloscope.

2. PRELIMINARY ADJUSTMENTS.

a. ADJUSTMENT.

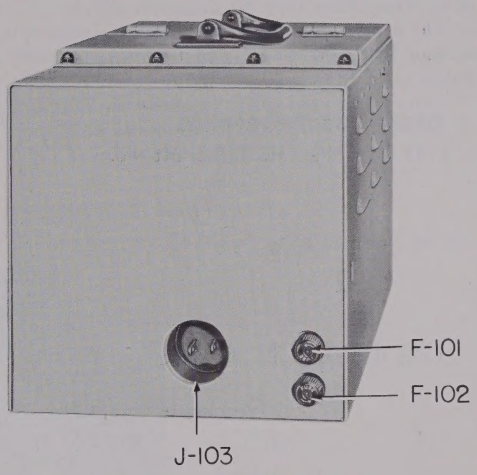


Figure 4-1. Rear View, Line Voltage Connection

(1) LINE VOLTAGE.—In Frequency Meters TS–186/UP, TS–186A/UP, and TS–186B/UP, it was necessary to reset the power transformer input tap for varying line voltages of 105, 115, and 125 v.a.c. In the TS–186C/UP and TS–186D/UP, however, the power transformer (T–201) is so designed to permit continuous, efficient operation from a source of 115 volts a.c. ±10% (single phase, 50-1000 cycles) without the need for resetting the primary tap of T–201. It is merely necessary to connect the power cable to J–103 on the rear of the equipment (see figure 4–1).

(2) RF INPUT WAVEGUIDE E–108.—This waveguide is a standard 1" x ½" guide with a plain flange. Another section of the same size guide may be coupled to E–108, after the cover plate is removed, to conduct the signal to be measured into the frequency meter. If a waveguide of another size is used

for this connection, an adapter must be used between E–108 and the other waveguide.

If a coaxial cable is to be used for this connection, the coaxial adapter J-104 must be attached to E-108 by first inserting the fork of the adapter so that it engages the probe passing through E-108 then securing the four mounting screws to hold the adapter in place (see figure 4-2). The vertical and horizontal spacing of these mounting screws is not the same so this part must be oriented properly before tightening the screws. The coaxial cable should be terminated in an Army-Navy type N connector, such as UG-18/U or UG-21/U connector or equivalent, otherwise an adapter will have to be used between the cable and J-104.

3. OPERATING PROCEDURE.

a. STARTING THE EQUIPMENT.

(1) POSITION OF CONTROLS.—IND SWITCH on "BEAT IND," XTAL CAL "ON," VOLUME fully counterclockwise, HET OSC "ON."

(2) POWER SWITCH S–102.—Turn to the "ON" position.

CAUTION

PRELIMINARY WARM-UP PERIOD.—Before attempting to use the equipment a 20-minute warm-up period must be allowed with both the POWER and HET OSC switches "ON." If the equipment is used before being thoroughly warmed up, the heterodyne oscillator frequency will drift excessively. If the HET. OSC. SWITCH is turned OFF for any reason, an additional warm-up period must be allowed until the heterodyne oscillator frequency stabilizes.

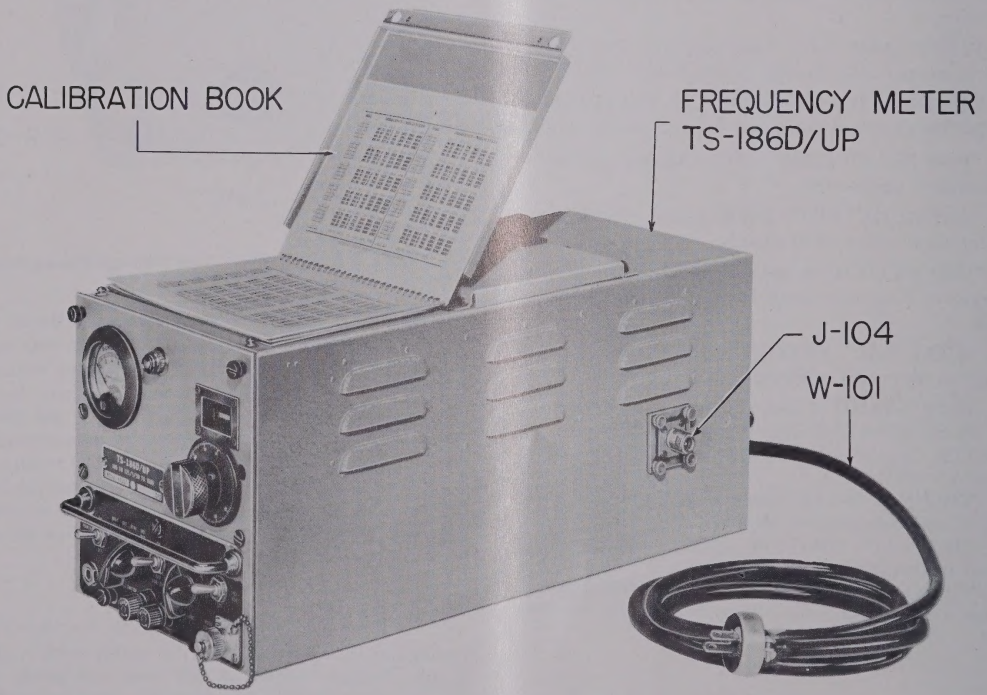


Figure 4-2. Oblique View, Coaxial Adapter (J-104 in Place)

(3) XTAL CAL. SWITCH.—The XTAL CAL. (S–101) switch may be turned *ON* or *OFF* at will without affecting the accuracy of the crystal check points. Therefore the check points may be used to determine when the heterodyne oscillator frequency stabilizes by noting whether the beat note is changing appreciably within a two-minute period.

(4) With the XTAL CAL switch to ON and the VOLUME control turned maximum counterclockwise, rotate the IND switch to each of its four positions and note the reading of M–101 at each position. The following values are typical of normal meter readings:

IND SWITCH Position	Meter M–101 Reading
Beat Ind	.8 to .9
Det	.2 to .4
Xtal	.02 to .05
Het. Osc.	6. to .95

b. HETERODYNE OSCILLATOR TUNING.

(1) Unfold the crank from the knob of the tuning dial assembly.

(2) Determine the dial setting corresponding to the desired frequency from the calibration book. The first group of figures in the entry is the counter reading and represents the number of dial revolutions. The second group is the actual dial setting. For example 136–47 represents a counter reading of 136 and a dial setting of 47.

(3) In adjusting the heterodyne oscillator tuning to a given dial setting, *always* approach the setting with a CLOCKWISE rotation of the tuning dial. The desired dial setting should then be made with *no* overshoot. Failure to observe these precautions may result in frequency errors.

CAUTION

Do not attempt to use this equipment for frequency measurement purposes until after a 20-minute preliminary warm-up period with both POWER and HET. OSC. switches turned *ON*. See paragraph 2*a*(2).

c. FREQUENCY MEASUREMENT.

(1) Connect the RF signal to be measured to the

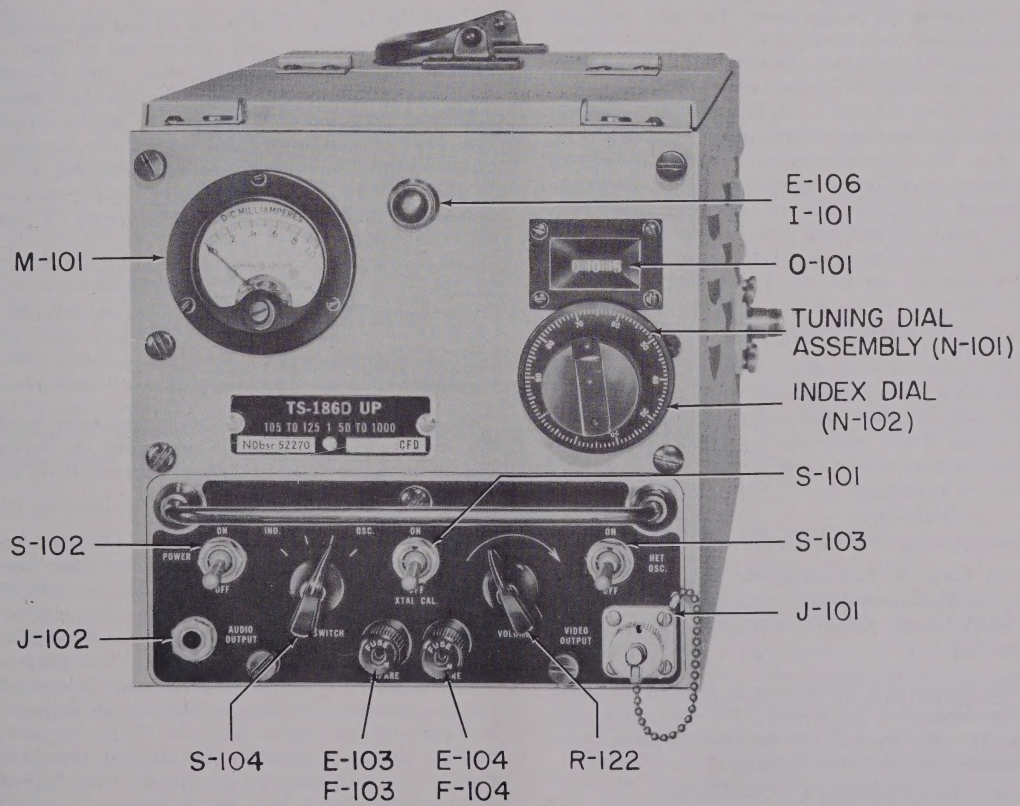


Figure 4-3. Front Panel

RF input on the right side of the unit. [See Section 4, paragraph 2*a*(3).]

(2) Plug a pair of 600-ohm headphones (Navy type 49016 or Army-Navy types H–1/AR or H–4/AR) into the AUDIO OUTPUT jack J–102 on the front panel.

(3) Adjust the VOLUME control for a suitable hearing level.

Note

When operating from a high frequency power supply, the hum level in the headphones may be reduced to a minimum by the hum adjustment as described in Section 5, paragraph 4*d*.

(4) From the calibration book select the dial setting corresponding approximately to the desired frequency (for example, if the frequency of the RF signal being measured is known to be between 300 and 400 megacycles, this might correspond to a dial setting between 54–40 and 111–72).

(5) With the XTAL CAL. switch turned *OFF* and HET. OSC. switch *ON*, tune the heterodyne oscillator slowly through this range until an audible beat signal is produced in the headphones. The beat indicator M–101, may be used as an aid in locating this audible beat. Turn IND. switch to BEAT IND. and watch for a dip in the meter indication which will occur before an audible beat is heard in the headphones. However, since the beat indicator does not respond to frequencies less than 100 cycles, the meter reading may rise as zero beat is heard in the headphones. After the meter has served its purpose, that is, indicating that a zero beat is being approached, tune for the zero beat as heard in the headphones and record the dial reading. (As an example, assume this dial setting is found to be 87–94).

(6) Turn the XTAL CAL. switch ON.

(7) Tune the heterodyne oscillator to the nearest crystal check point as determined from the calibration book. Since the above dial reading is 87–94, the adjacent crystal check points (in red type) listed in the calibration book may be, for example:

352.5 Mcs.	88–70
350.0 Mcs.	87–30

the nearest being 350.0 mcs. at 87–30.

(8) Tune the heterodyne oscillator to zero beat with this check point when rotating the tuning dial CLOCKWISE and without OVERSHOOTING the correct setting.

(9) Correct this dial setting by rotating the index dial (see figure 4–4) which carries the index mark until the index coincides with the dial reading given in the calibration book (87–30 as above).

(10) Turn the XTAL CAL. switch *OFF*.

(11) Tune in the RF signal again with a CLOCKWISE rotation of the tuning dial (without overshooting the setting at which zero beat occurs). This setting may now have changed from 87–94 to 87–96 because of the dial correction made in paragraph 2*c*(9).

(12) Using adjacent *interpolation* points in the calibration book (four of which are located between each set of crystal check points) calculate the frequency of the RF signal as follows:

(a) Corrected tuning dial setting for the RF signal from paragraph 2*c*(11) is 87–96.

(b) Adjacent interpolation points from calibration book

351.5 Mcs.	88–14
351.0 Mcs.	87–86
0.5 Mcs.	28 dial divisions

(c) Difference between RF signal dial setting and lower interpolation point

RF Signal	87–96
Lower Interp. Pt.	87–86
Difference	10 dial divisions

(d) RF signal frequency

$$(351 + \frac{10}{28} \times 0.5) \text{ Mcs.} = 351.18 \text{ Mcs.}$$

(13) If no idea is had of the value of an unknown frequency, it may be roughly determined by means of an external receiver or wave meter. For example, assume that an unknown signal is found to lie between 1,000 and 2,000 mc. Referring to the sample calibration chart shown below and noting the harmonic relationship for any one particular dial setting, it can be seen that the unknown frequency is between the heterodyne oscillator fundamental frequency "F" and its second harmonic "2F."

DIAL	FREQUENCY—(MEGACYCLES)					
—	250.0	500.0	1,000	2,000	4,000	8,000
	$\frac{F}{4}$	$\frac{F}{2}$	F	2F	4F	8F

From this chart, it is noted that the unknown signal "F_x" will produce an audible beat when the tuning dial is moved to cover the range between 500.0 mc. $\left(\frac{F}{2}\right)$ and 1,000 mc. (F). The reason for selecting this range rather than the range between 1,000 mc. and 2,000 mc. is to avoid the odd harmonic frequency beats that would make harmonic identification difficult. With the instrument in operation and the unknown signal applied, the tuning dial is set to the reading that will represent the starting point of the 500.0 to 1,000 mc. range. In an actual measurement being made for this example, the dial reading of the Frequency Meter TS–186B/UP being used was 10–04. By slowly turning the dial towards the higher frequencies (higher dial numbers), a beat will be heard between the unknown signal and the heterodyne oscillator. Recording the tuning dial setting, which in this case

was 65–78, and then referring to page 13 of the Calibration Book, the frequency was found to be 625 mc. Again referring to the harmonic relationship as shown on the sample chart, it can be seen that the harmonic range is $\frac{F}{2}$. Thus the recorded frequency is one-half of the value of the unknown signal frequency which is 625 × 2 or 1,250 mc. To verify the results, the above may be repeated using the next lower harmonic range: 250.0 to 500.0 mc. A beat will then be heard at a dial setting corresponding to a frequency of 312.5 mc. and from the sample chart it is seen that this frequency range is $\frac{F}{4}$. The frequency of the unknown signal is therefore 312.5 × 4 or 1,250 mc.

Generally, the unknown may be a source of signal that is relatively free from spurious responses (harmonics) and the identification of the unknown fundamental frequency can be readily noted as the beat heard and observed on the Frequency Meter TS–186D/UP at one dial setting. From this, the corresponding frequency is obtained from the Calibration Book. If there are spurious responses from the unknown signal, the resultant beats will be successively weaker as the Frequency Meter is being tuned away from the unknown fundamental frequency.

(14) In the case where an unknown signal to be measured lies between 2,000 and 10,000 mc. and no auxiliary equipment is available for a rough approximation of its value, the following procedure is recommended.

(a) With Frequency Meter TS–186D/UP operating, the tuning dial is set to the maximum frequency point, 10,000 mc. In the unit being used for this example the dial reading was 175–37 on page 17 of the Calibration Book.

(b) The tuning dial is slowly turned counterclockwise (lower frequency) until a beat is heard in the headphones and a maximum indication observed on the beat indicator M–101. In most cases this will mean overshooting the exact frequency point. Slowly turn the turning dial clockwise back toward the maximum indicated beat point and note the tuning dial reading.

Note

In readjusting the heterodyne oscillator to a given beat, always approach the beat with a CLOCKWISE rotation of the tuning dial. This will provide maximum accuracy of frequency measured, since the frequency meter is initially calibrated in a clockwise direction. At these high frequencies failure to observe this precaution may result in frequency error.

(c) The dial setting recorded in this example was 169–0 on page 16 of the Calibration Book. The frequencies shown for this reading are: 295.0 590.0 1,180 2,360 4,720 9,440. As previously stated, the signal being measured is known to lie between 2,000 and 10,000 mc., hence, the lower readings would not apply. Assuming that 9,440 mc. is the unkown signal frequency and observing the amount of dip on meter M–101 at this setting, the tuning dial is again moved to check one-half of 9,440 mc. or 4,720.

(d) Consult the Calibration Book to find the tuning dial reading for 4,720 mc. which appears on page 4. In this example, the reading was 53–03. If the beat is again heard and observed at the new setting, but the audible signal is weaker and the amount of meter dip is smaller than that observed at the higher frequency setting, the unknown signal frequency is 9,440 mc.

(e) If the beat heard and observed at 4,720 mc. had been stronger than the beat and dip at 9,440 mc., this would indicate that the fundamental frequency of the unknown signal is 4,720 mc.

(f) Generally, the majority of signals to be measured from signal generators, transmitters, etc., are more or less free of spurious responses (harmonics). If, however, a defective unit such as a signal generator or transmitter is being checked for spurious responses, auxiliary equipment MUST be used with Frequency Meter TS–186D/UP to first roughly identify the frequencies that are to be measured.

d. RECEIVER CALIBRATION.—Frequency Meter TS–186D/UP may also be used for receiver calibration in the range from 500 to 1,250 megacycles by using the RF output of the heterodyne oscillator.

(1) Attach coaxial adapter J-104 to the RF input on the right side of the unit. (See figure 4-2.)

(2) Connect input of the receiver to be calibrated to the coaxial adapter by means of approximately 11 ft. of RG–8/U cable or equivalent. Shielded cables such as microphone cables or other high-capacity devices should not be used.

(3) Turn Frequency Meter TS–186D/UP *ON*.

(4) Turn HET. OSC. switch *ON*.

(5) Turn XTAL CAL. switch *OFF*.

With the equipment connected as described, the receiver will be supplied with an unattenuated, unmodulated signal at the fundamental frequency of the heterodyne oscillator. Tuning dial settings for desired values of frequency may be obtained from the Calibration Book.

The instruction book of the receiver should be referred to for proper calibration procedure.

FAILURE REPORTS

A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from any Electronics Officer.

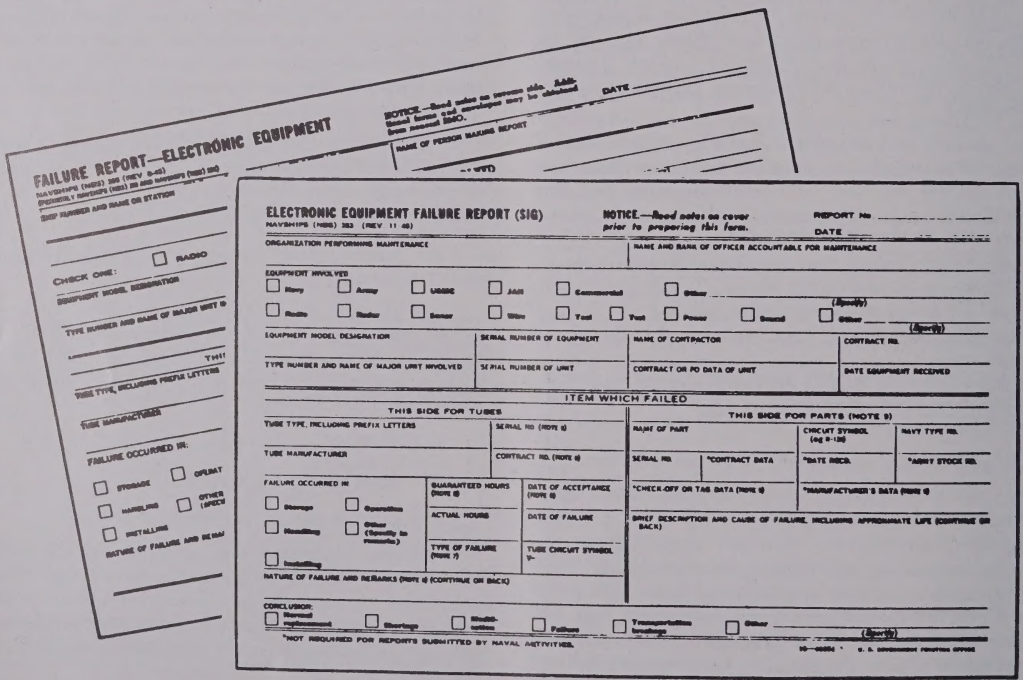

FAILURE REPORT—ELECTRONIC EQUIPMENT
ELECTRONIC EQUIPMENT FAILURE REPORT (SIG)
NOTICE.—Read notes on cover prior to preparing this form.
REPORT No
DATE
ORGANIZATION PERFORMING MAINTENANCE
NAME AND RANK OF OFFICER ACCOUNTABLE FOR MAINTENANCE
EQUIPMENT INVOLVED
EQUIPMENT MODEL DESIGNATION
SERIAL NUMBER OF EQUIPMENT
NAME OF CONTRACTOR
CONTRACT NO.
TYPE NUMBER AND NAME OF MAJOR UNIT INVOLVED
SERIAL NUMBER OF UNIT
CONTRACT OR PO DATA OF UNIT
DATE EQUIPMENT RECEIVED
ITEM WHICH FAILED
THIS SIDE FOR TUBES
TUBE TYPE, INCLUDING PREFIX LETTERS
SERIAL NO (NOTE 6)
TUBE MANUFACTURER
CONTRACT NO. (NOTE 6)
FAILURE OCCURRED IN:
GUARANTEED HOURS (NOTE 6)
DATE OF ACCEPTANCE (NOTE 6)
ACTUAL HOURS
DATE OF FAILURE
TYPE OF FAILURE (NOTE 7)
TUBE CIRCUIT SYMBOL
NATURE OF FAILURE AND REMARKS (NOTE 6) (CONTINUE ON BACK)
THIS SIDE FOR PARTS (NOTE 5)
NAME OF PART
CIRCUIT SYMBOL (eg R-126)
NAVY TYPE NO.
SERIAL NO.
*CONTRACT DATA
*DATE RECD.
*ARMY STOCK NO.
*CHECK-OFF OR TAG DATA (NOTE 6)
*MANUFACTURER'S DATA (NOTE 6)
BRIEF DESCRIPTION AND CAUSE OF FAILURE, INCLUDING APPROXIMATE LIFE (CONTINUE ON BACK)
CONCLUSION:
*NOT REQUIRED FOR REPORTS SUBMITTED BY NAVAL ACTIVITIES.

Figure 5–1. Failure Report Form, Sample

SECTION 5

MAINTENANCE

1. OPERATOR'S MAINTENANCE.

WARNING

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause has been corrected.

a. Frequency Meter TS–186D/UP is protected by two 2 ampere fuses removable from the rear panel. Two spare fuses are also contained in the front panel holders marked "Fuse, Spare" for replacement purposes. (See figure 4-1 and 4-3.)

SYMPTOMS OF FUSE FAILURE.

(1) Pilot light doesn't light.

(2) No signal indication either in the headphones or no movement of panel meter needle.

(3) Voltage regulator tubes V–109 and V–110 and filaments in other exposed electron tubes do not glow.

b. TUBE REPLACEMENT. *(See figure 5–2.)*

(1) It is not recommended that tubes V–101, V–102 and V–107 be replaced in the field because of the probable effect on the existing alignment or calibration of the Frequency Meter. (See Section 5, paragraph 4.) However, tubes V–103, V–104, V–105, V–106, V–108, V–109 and V–110 may be replaced if defective without affecting either alignment or calibration.

2. PREVENTIVE MAINTENANCE.

a. Preventive maintenance, including inspection, tightening and cleaning of the components in the Frequency Meter, should be performed at regular intervals when it is turned off to eliminate major break-downs and interruptions in service and to maintain operation at top efficiency. It is recommended that the following steps be taken at least once a month especially if the Frequency Meter is in constant use.

(1) Remove equipment from case and carefully inspect all parts above and below chassis for color, placement, state of cleanliness, etc. Overheating of components will be generally indicated by discoloration, blistering or bulging, leakage of insulation compounds and oxidation of metal contact surfaces.

(2) Check all leads and cabling for proper position.

(3) Check and tighten any components which have become loose. See that electron tubes are tight in their sockets and tube clamps closed.

CAUTION

Be careful not to tighten mounting screws or nuts beyond the pressure for which they are designed.

(4) Examine unit for the accumulation of dust, especially between connecting terminals. Parts, connections and joints should be free of corrosion and other foreign matter.

(5) Check Power Cable W–101 for signs of deterioration, excessive wear, cuts or kinks and replace if necessary.

3. CORRECTIVE MAINTENANCE.

a. GENERAL TROUBLE-SHOOTING.

(1) Table 5-1, Trouble-Shooting Chart, can be used as a quick guide in recognizing and correcting common troubles which may occur when operating this equipment.

b. USES OF METER M–101 AS A SIGNAL TRACER.

(1) Meter M–101 can be very useful in rapidly checking the normal operation of Frequency Meter TS–186D/UP. When the IND SWITCH S–104 is on "DET," "BEAT IND" or "HET OSC" positions, the cathode currents of V–103, V–106 and V–107, respectively, are indicated. When the switch is set to "XTAL" position, the grid current of V–101 is indicated. The readings obtained under normal operating conditions are shown in table 5-2. Multipliers are also given in order that actual values of current in milliamperes can be obtained.

(2) By use of the IND SWITCH S–104 and Meter M–101, the normal circuit functions of the crystal calibrator, detector, heterodyne oscillator and audio amplifier can be rapidly checked.

(3) When checking the equipment with Meter M–101, the sequence of steps below should be followed:

(a) IND SWITCH IN "XTAL" POSITION.—No reading obtained. Crystal Y–101 or oscillator tube V–101 is defective; trimmer capacitor C–101 is shorted.

(b) IND SWITCH IN "DET" POSITION.—Low reading or no reading obtained. V–101, V–102, V–103, V–108, CR–101 or Y–101 defective.

TABLE 5–1. TROUBLE-SHOOTING CHART

TYPE OF TROUBLE	POSSIBLE CAUSE AND REPAIR
Pilot light off when power switch S–102 is on.	Pilot lamp I–101 burned out; fuse F–101 or F–102 blown; power transformer T–101 defective. Replace defective part.
Voltage regulator tubes V–109, V–110 do not glow.	Fuse F–101 or F–102 blown; rectifier tube V–108 defective; shorted or leaking filter capacitors C–139, C–140; low line voltage; power transformer T–101 defective. Replace defective part.
No calibration check points when XTAL CAL switch S–101 is on.	Tubes V–101, V–102 defective; crystal Y–101 defective. Replace defective part.
Heterodyne oscillator does not oscillate when HET OSC switch S–103 is on.	Plate by-pass capacitor C–131 shorted (see Section 5, paragraph 5*a*(2) for method of replacement); tube V–107 defective. Replace defective part.
Shift in frequency calibration.	Knurled socket mounting ring for X–107 loose.
Volume of audio beats in headphones becomes very low over entire Frequency Meter range. No audio output.	Detector-mixer tube V–103 defective; audio amplifier tubes V–104, V–105 defective; selenium rectifier CR–102 defective. Replace defective part.
Volume of audio beats in headphones decreases when frequencies above 1,000 mc. are being measured.	Crystal rectifier CR–101 defective. Replace defective part.
Excessive noise in audio amplifier evidenced by Meter M–101 reading erratically over its entire range when XTAL CAL and HET OSC switches S–101 and S–103 are in off position.	Crystal rectifier CR–101 loose in holder; intermittent shorts or loose elements in tubes V–103, V–104 or V–105. Tighten CR–101 holder. Replace defective tubes.

(c) IND SWITCH IN "HET OSC" POSITION. —Low reading or no reading obtained. V–107, V–108 or associated components defective.

(d) IND SWITCH IN "BEAT IND" POSITION. —With volume control R–122 fully counterclockwise, meter reading should be in accordance with table 5–2. If it is not, V–106, V–108 or associated components may be defective. An incorrect setting of R–130 will also give an erroneous indication. With volume control in maximum clockwise position and "XTAL CAL" and "HET OSC" switches S–101 and S–103 OFF, meter reading should decrease. No change in meter reading indicates defective V–103, V–104, V–105 or associated components.

TABLE 5–2. NORMAL METER READINGS AND MULTIPLIERS

SWITCH POSITION	METER READING	MULTIPLY BY
BEAT IND.	.8 to .9	1
DET.	.2 to .4	8.2
XTAL	.02 to .05	1
HET. OSC.	.6 to .95	25

4. ALIGNMENT AND CALIBRATION PROCEDURE.

a. BEAT INDICATOR.—If Meter M–101 does not indicate the proper values as given in paragraph 3*b*(3)*(d)* after repairs have been made, the screen grid voltage of V–106 should be adjusted by means of potentiometer R–130 located on the chassis.

(1) With the XTAL CAL and HET OSC switches *OFF* turn the IND SWITCH to the BEAT IND position. TURN VOLUME CONTROL TO EXTREME COUNTERCLOCKWISE POSITION.

(2) Unlock control R–130 on the chassis (see figure 5–2), and by means of a screw driver adjust this potentiometer for a reading of approximately 0.9 milliamperes on meter M–101. Tighten the lock-nut on R–130.

b. CRYSTAL CALIBRATOR.

(1) CRYSTAL OSCILLATOR FREQUENCY ADJUSTMENT.—The quartz crystal Y–101 used in this equipment produces a frequency that is 5,000 kc. ± 100 cycles and this is adjusted by means of capacitor C–101 so that the oscillator frequency is exactly 5,000 kc. In order to maintain greatest possible accuracy of measurements, this frequency should be periodically checked. It should also be checked and adjusted when the oscillator tube V–101 is changed. To adjust the crystal oscillator frequency, follow the procedure outlined in the following paragraphs.

(a) TEST EQUIPMENT REQUIRED.

1. A precision frequency standard having a frequency of 5,000 kc., 10,000 kc., 15,000 kc., or 20,000

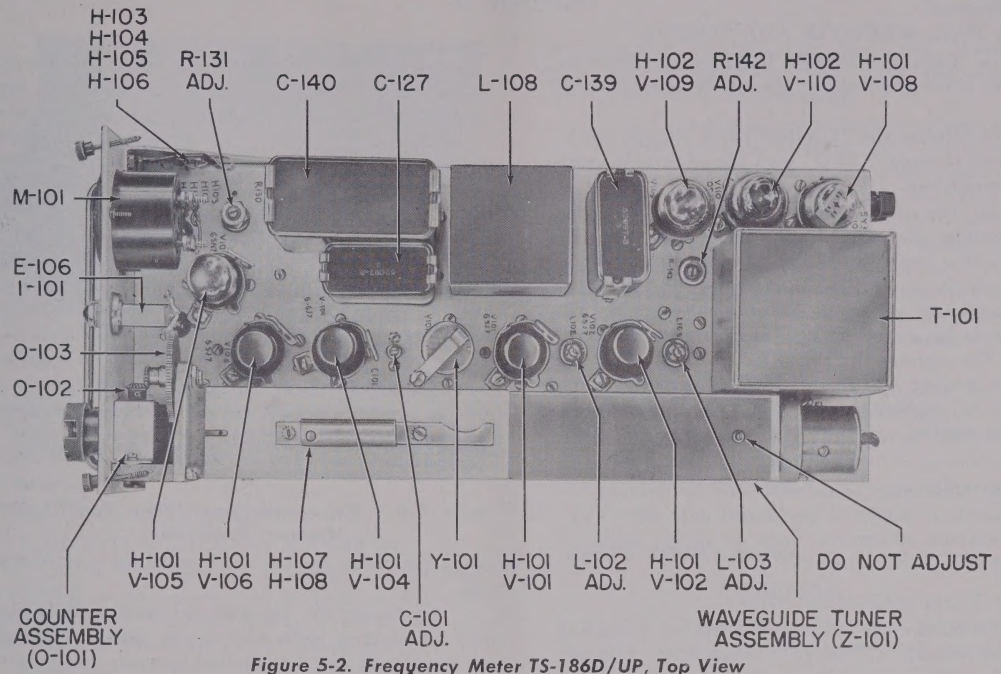


Figure 5-2. Freqyency Meter TS-186D/UP, Top View

kc., with an accuracy of 0.0001 percent or better (one part per million).

2. Radio Station WWV of the National Bureau of Standards, Washington, D. C., broadcasts standard frequencies of 5,000 kc., 10,000 kc., and 15,000 kc. accurate to within one part in ten million. If these signals can be received they may be used in place of the frequency standard mentioned in the preceding paragraph.

3. A standard radio receiver tunable to one of the above frequencies.

CAUTION

The crystal oscillator frequency should not be adjusted until after a preliminary 20-minute equipment warm-up period to permit the heater of the crystal unit Y–101 to reach the proper operating temperature.

(b) PROCEDURE.

1. Adjust the receiver to pick up one of the above mentioned standard signals.

2. Turn the XTAL CAL switch *ON*. With the TS–186D/UP equipment removed from its case there will usually be sufficient radiation so that the receiver also will pick up the 5,000 kc. fundamental of the crystal oscillator or one of its harmonics, which will beat with the standard signal being received.

3. The 440 cycle audio modulation is removed from WWV's carrier for one minute out of every five. Wait until this modulation is off, and then loosen the lock-nut and adjust trimmer capacitor (see figure 5–2) until the difference beat-frequency at receiver output between the two signals is as near zero as possible. Tighten the lock-nut.

CAUTION

If this adjustment is first made while the audio modulation is present on the standard carrier frequency, it is possible to adjust the crystal oscillator frequency to zero beat with one of the side-bands present causing a serious error in the frequency adjustment.

(2) 10 AND 20 MEGACYCLE TUNING.—This alignment should be made following the replacement of V–101, V–102 or associated components.

(a) Turn XTAL CAL switch *ON*, HET OSC switch *OFF* and IND SWITCH to *DET*. Adjust the screw driver operated iron core of the 10 mc. tuning inductor L–102, located on the chassis, for a peak reading of meter M–101. This adjustment will have no effect on the crystal-oscillator frequency.

(b) Adjust the screw driver operated iron core of the 20 mc. tuning inductor, L–103, on the chassis for a peak reading of meter M–101.

c. HETERODYNE OSCILLATOR.

CAUTION

The procedure outlined herein should be necessary only after replacing the electron tube V–107 or other critical components of the waveguide assembly.

(1) DIAL—COUNTER ADJUSTMENT.

(a) Turn the TUNING DIAL counterclockwise until the casting is stopped against the front bearing block.

(b) Rotate the TUNING DIAL slightly clockwise until it reads "ZERO" with the adjustable index mark straight up.

(c) The counter should read 000, and the right-hand counter dial should advance from *zero* to *one* as the dial is rotated clockwise past a reading of *zero.*

(d) To correct the counter reading, loosen the two screws "A" (see figure 5–7) which will allow the counter to be moved enough to disengage the bevel gears. The counter shaft may then be turned to correct the reading. When this is accomplished, tighten screws "A," making certain that the bevel gears are properly meshed.

CAUTION

The following adjustment and calibration procedure should be performed only after a 20-minute equipment warm-up period with the HET. OSC. switch *ON.*

(2) PUSH ROD ALIGNMENT.

(a) Rotate the TUNING DIAL to a reading of approximately 125–00 (875 megacycles—mid frequency).

(b) Remove the dust cover from the micrometer lead screw mechanism by removing the single mounting screw from the front top-side of the cover and sliding the cover upward and toward the rear of the unit.

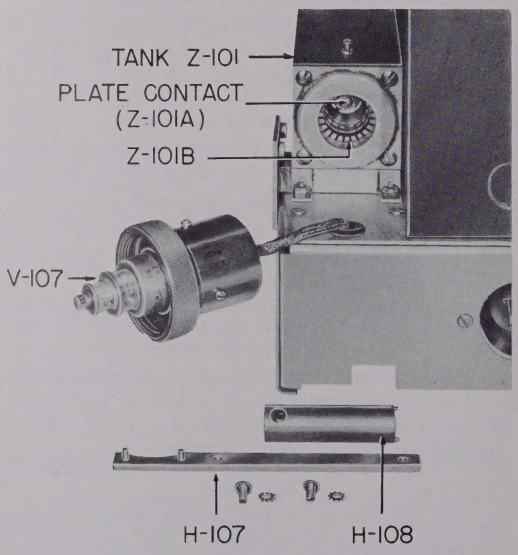


Figure 5–3. Waveguide Tuner, V–107 Removed

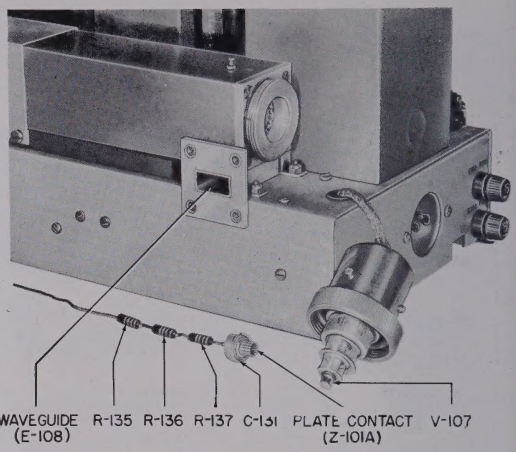


Figure 5–4. Waveguide Tuner, Plate Contact and Resistors Removed

(c) Loosen the six 4–40 hex nuts holding the inner set of three push rods to the phenolic disc so that these rods may be adjusted over the full length of the threaded portion. (See figure 5-9.)

(d) Turn the IND. SWITCH to the *HET. OSC.* position and rotate the TUNING DIAL which will then cause only the outer rods to be moved. Adjust the relative positioning of the two sets of push-rods in this manner for a maximum reading of meter M–101. Tighten the nuts.

CAUTION

When tightening the nuts on the push rods, first draw up nuts on the carrier side of the phenolic disc until all three nuts just touch the disc. Next, tighten the nuts on the tank side of the phenolic disc. This precaution is necessary to insure proper positioning of the contact ring inside the tank.

(e) Tune the heterodyne oscillator over its full range, noting the reading of the milliammeter M–101. Loosen and adjust the feedback screw (see figure 5–9) at the top face of the tank assembly so that meter M–101 reads at least 0.6 of full scale (15 ma.) over the entire range. Tighten the feedback screw.

(f) Turn the XTAL CAL. switch *ON* and tune the heterodyne oscillator to the 500 megacycle crystal check-point using an auxiliary signal generator to identify this check point. [See paragraph 4*c*(3).]

***(g)* Carefully adjust the heterodyne oscillator to zero beat with the 500 megacycle check-point using a clockwise rotation of the tuning dial in approaching the final setting. Do not overshoot this setting, or a backlash error will be introduced.**

(b) Carefully loosen all 12 hex nuts holding both sets of push rods without disturbing the adjustment. Run the nuts to the extreme ends of the threaded portion of the rods, if necessary, to allow adjustment leeway.

(i) Rotate the tuning dial to the setting listed in the calibration book for 500 megacycles. The dial should be turned clockwise in approaching the final setting which should be made without overshooting.

(j) Carefully tighten all nuts on the push rods [see CAUTION paragraph *4c(2)(d)*] and re-check the dial reading for the 500 megacycle crystal check-point. If in error by more than 10 dial divisions, the above procedure should be repeated.

(k) Check several other points throughout the frenquency range of the heterodyne oscillator and if in error by more than 10 dial divisions, the unit should be recalibrated as described in the following paragraphs.

(3) FREQUENCY CALIBRATION.

(a) TEST EQUIPMENT REQUIRED.

1. A radio frequency standard or an auxiliary RF signal generator such as Navy Model LX series, or RF Signal Generator Set AN/URM-26 (accuracy 0.1 percent) either of which has a fundamental frequency between 100 and 500 megacycles. It must be possible to obtain harmonics corresponding to some crystal check-point frequencies over the fundamental tuning range of the heterodyne oscillator. These are listed in the calibration book in red type.

2. A pair of headphones should be plugged into the AUDIO OUTPUT jack J–102.

CAUTION

The heterodyne oscillator should be calibrated only after a 20-minute warm-up period with both POWER and HET. OSC. switches *ON*.

(b) PROCEDURE.—The above signal generator is used only to identify various crystal check-points. The actual frequency calibration of the heterodyne oscillator is made in terms of these check-point frequencies and not the auxiliary signal generator.

1. Connect the auxiliary RF signal to the RF INPUT (J–104). The signal level should be at least 10,000 microvolts for ease of calibration.

2. With the XTAL CAL. switch S–101 *OFF*, tune the heterodyne oscillator to a harmonic of the auxiliary signal preferably near 500 megacycles or between 500 and 600 megacycles.

3. Turn the XTAL CAL. switch *ON* and retune for a beat with the nearest five megacycle crystal check-point. Record the dial setting corresponding to this frequency.

4. Either disconnect the auxiliary RF signal from the RF INPUT or turn it off at the source.

5. Tune in each main five megacycle crystal calibrator beat in succession down to and including 500 megacycles, recording each dial setting. If possible check the 500 megacycle point using the auxiliary signal generator as outlined above.

6. Retuning the heterodyne oscillator to the original setting obtained in paragraph *4c(3)(b)* above, tune in each five-megacycle crystal check-point up to and including 1,250 megacycles, recording each dial reading. Approximately every twentieth crystal calibrator beat should be double checked against a harmonic of the auxiliary RF signal. This is recommended to insure that a crystal beat has not been overlooked or that one of the weaker beats present between the main five megacycle beats has not been included in error.

d. HUM ADJUSTMENT.—To minimize the hum heard in the phones, adjust the potentiometer R–142 located on the chassis near the power transformer T–101 (see figure 5–2). The optimum adjustment will vary somewhat with power supplies of different frequencies.

5. PARTS REPLACEMENT.

CAUTION

After replacing any part listed in this paragraph the heterodyne oscillator may require realignment and recalibration as covered in paragraph *4c* of this section.

a. HETERODYNE OSCILLATOR ASSEMBLY.

(1) ELECTRON TUBE REPLACEMENT (V-107).—This electron tube is located at the rear of the heterodyne oscillator tank. Loosen the knurled ring nut by means of the spanner wrench supplied (H–107). The electron tube and socket shell assembly can now be removed and the tube replaced in the usual manner. Care should be taken in removing and re-inserting electron tube V–107 that the contact fingers on the cathode contact disc within the waveguide are not damaged. When re-tightening the knurled ring nut, use the spanner wrench and remove *all* play between the socket shell and the main tank. ***Failure to completely tighten the ring nut may result in frequency instability.***

(2) CAPACITOR REPLACEMENT (C–131).

(a) Unsolder and remove the blue plate lead from the terminal of capacitor C–123–C under the chassis. (See figure 5-6.)

(b) Uncable this lead back to the point where it goes through the hole in the chassis into the heterodyne oscillator compartment.

(c) Remove the dust shield from the front of the waveguide assembly by removing the single holding screw in the front bearing block and lifting upward and toward the rear of unit.

(d) Pull the blue plate lead through to the top of the chassis.

(e) Remove electron tube V–107 as covered in paragraph *5a(1)* of this section.

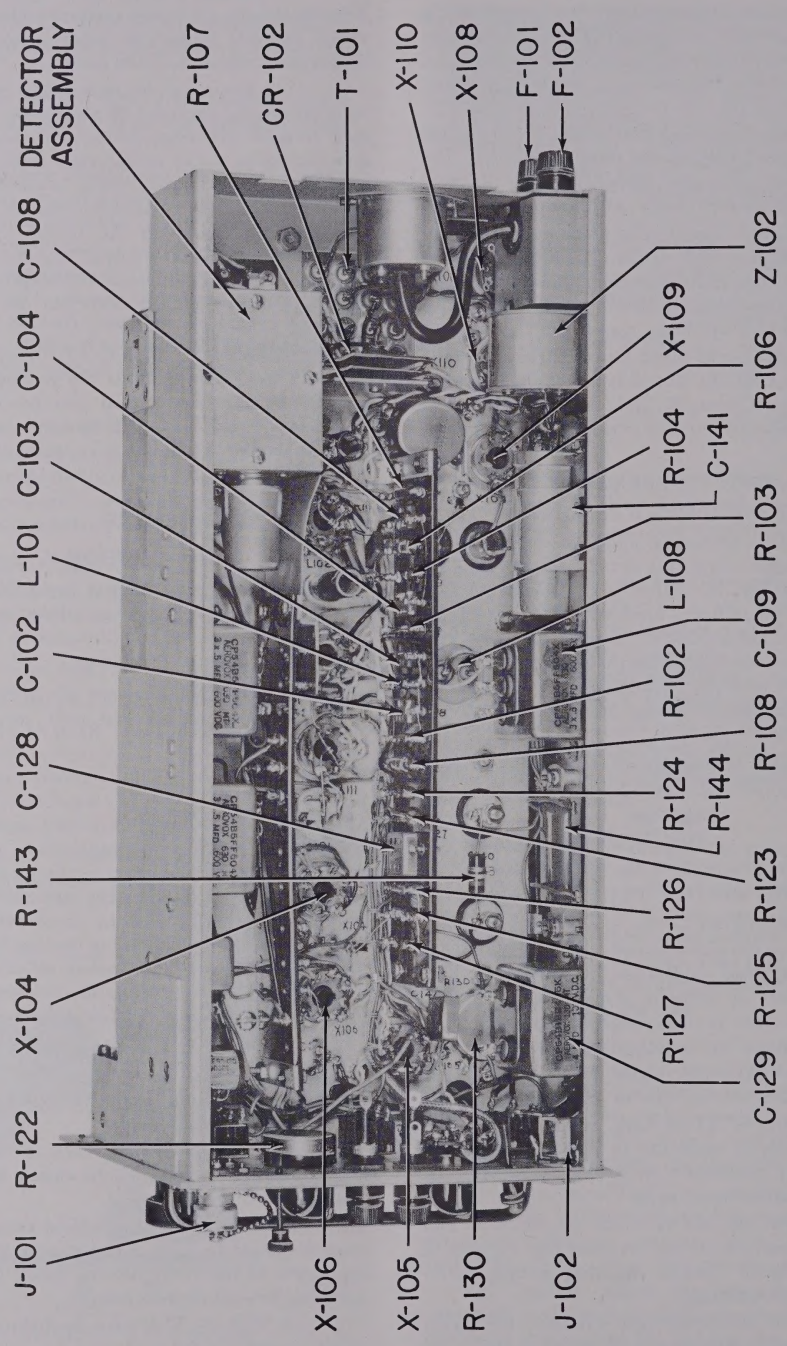


Figure 5-5. Frequency Meter TS-186D/UP, Bottom View (right oblique)

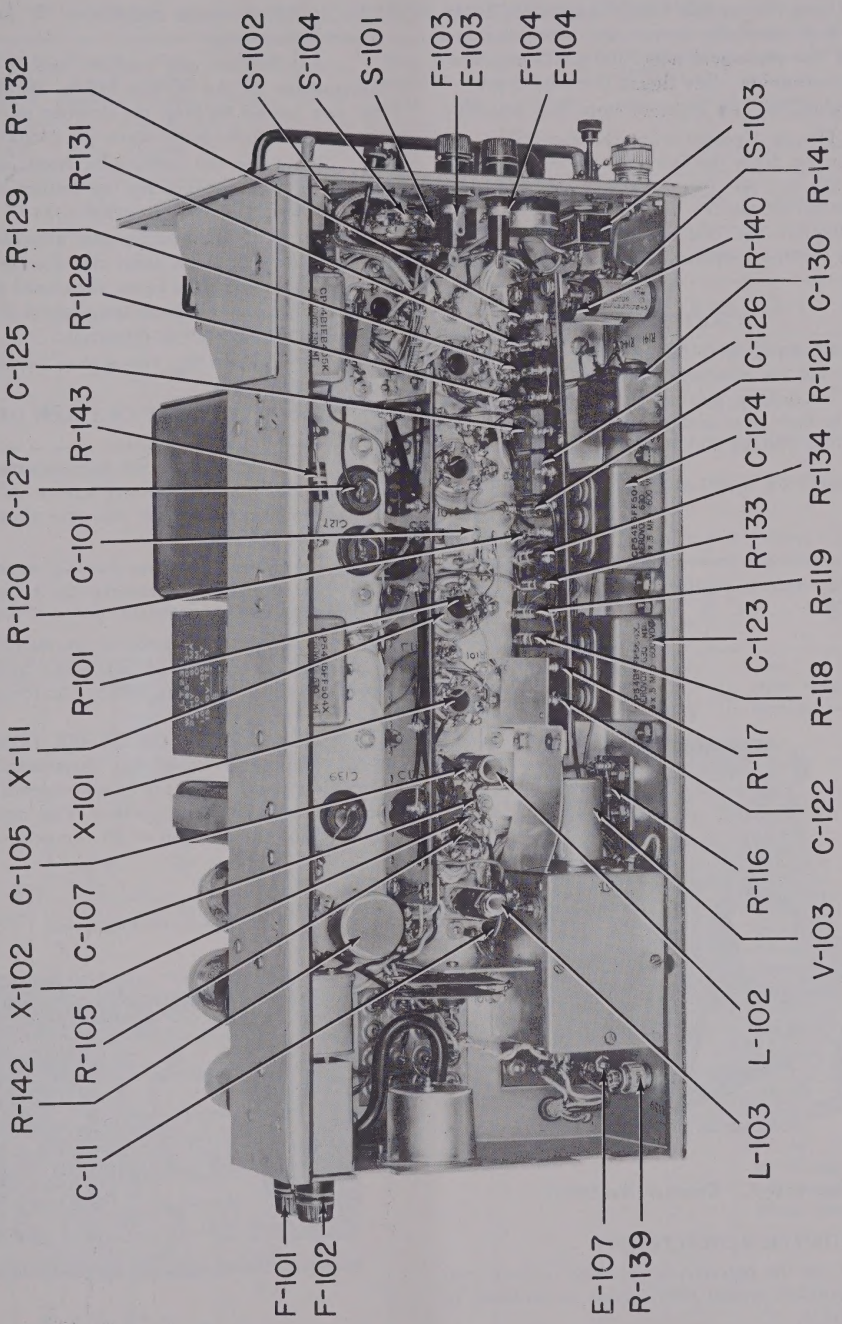


Figure 5-6. Frequency Meter TS-186D/UP, Bottom View (left oblique)

(f) Using the spanner wrench supplied (H–114, see figure 5-2) carefully loosen the plate-connector assembly of the plate-grid tank, and pull completely out of the waveguide. (See figures 5–3 and 5–4.)

(g) Unsolder the resistors from this assembly.

(h) The gold plated mica disc capacitor C–131 may be removed from the front of this assembly after removing the hex nut from the rear side and withdrawing the plate contact.

(i) Replace the disc capacitor C–131 and reassemble the various components in reverse order to that listed above.

CAUTION

The disc capacitor C–131 is easily damaged and should be handled with care. If there is any fracture in the mica, the capacitor is likely to flash over and cause a short circuit when plate voltage is applied.

(3) RESISTOR REPLACEMENT R–135, R–136, R–137.

(a) To replace one of these resistors follow the procedure outlined above in paragraph 2*a*(2), subsection *(a)* through *(g)* inclusive.

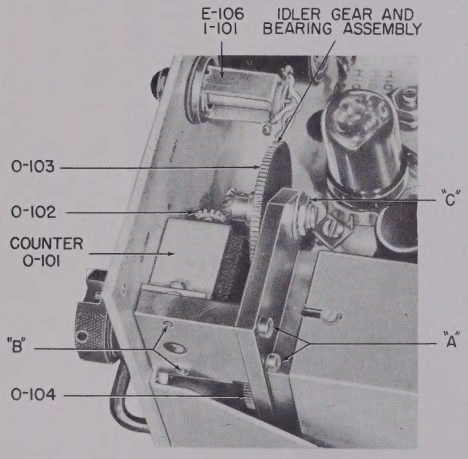


Figure 5–7. Counter Assembly

(4) COUNTER REPLACEMENT.

(a) Tune the heterodyne oscillator to zero beat with an identified crystal check-point as outlined in paragraph 4*c*(3).

(b) Remove the two screws "A" in figure 5–7, holding the counter mounting block to the front gear plate and remove the assembly.

(c) Remove the two screws "B" from the counter mounting strap.

(d) Replace the counter and re-assemble the components in the reverse order. Before tightening the two screws holding the counter mounting block, the counter dials should show the correct reading.

(e) From the calibration book, determine the proper counter reading for the setting of the heterodyne oscillator used in paragraph *(a)*.

(f) With the counter gear unmeshed rotate the counter shaft by hand until the dials read correctly. The gears should then be so positioned that the right hand counter dial advances one digit as the tuning dial passes zero in a clockwise direction.

(g) Tighten the two screws holding the counter mounting block.

(5) REPLACEMENT OF IDLER GEAR ASSEMBLY.

(a) It is necessary to first remove the counter assembly by removing the two screws "A" holding the counter mounting block to the gear plate. (See figure 5–7.)

(b) Remove the next nut "O" at the rear of the idler gear bearing and remove the entire idler gear and bearing assembly.

(c) Replace all items in reverse order following the procedure outlined in paragraph 5*a*(4) for obtaining the proper counter reading, omitting paragraphs *(b)* and *(c)*.

b. REPLACEMENT OF OTHER COMPONENTS. —All components, other than those mentioned in the preceding paragraphs, are readily accessible and may be replaced in the usual manner. (See figures 5–5, 5–6, and 5–8 for the location of all components.)

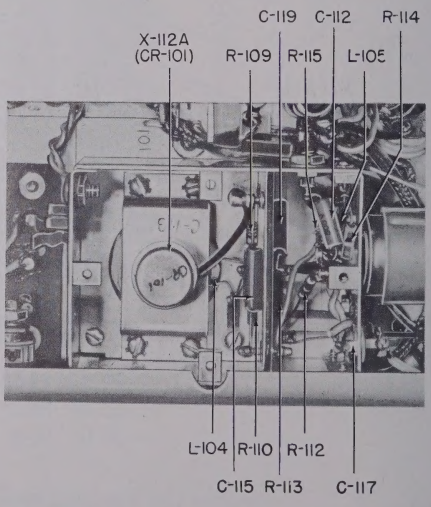


Figure 5–8. Detector Unit, Cover Removed

TABLE 5–3. RATED ELECTRON TUBE CHARACTERISTICS

Tube Type	Filament Voltage (Volts)	Filament Current (Amperes)	Plate Voltage (Volts)	Grid Bias (Volts)	Screen Volts	Plate Current (MA)	Screen Current (MA)	A.C. Plate Resistance (Ohms)	Voltage Amplification Factor	Transconductance		Emission	
										Normal	Minimum	Is (MA)	Test Volts
6SJ7	6.3	0.3	250	—3	100	3.0	0.8	Greater than 1 Meg.	100	1,575	1,325	0.06	30
2C40	6.3	0.75	250	RK = 200 Ohms	—	22.0	—	7,500	36	4,800	4,400	Eb = 40 RK = 0	10
12AT7*	6.3	0.3	100	RK = 240 Ohms	—	3.7	—	13,500	54	5,500	4,500	—	—
6SN7GT*	6.3	0.6	250	—8	—	9.0	—	7,700	20	2,600	2,075	40	30
5Y3GT	5.0	2.0	MAX. D. C. OUTPUT CURRENT—125 MA.; MAX. INVERSE PEAK VOLTS—1400; PEAK PLATE CURRENT—375 MA.										
OD3/VR–150	—	—	MIN. STARTING VOLTS—180; OPERATING VOLTS—150; OPERATING CURRENT 5–40 M. A. D. C.										

* VALUES ARE FOR EACH TRIODE SECTION.

TABLE 5–4. WINDING DATA

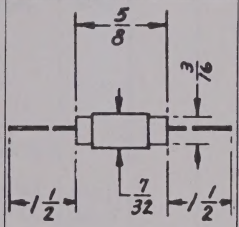
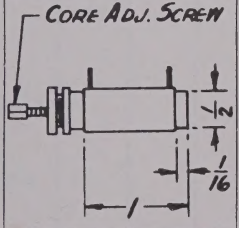
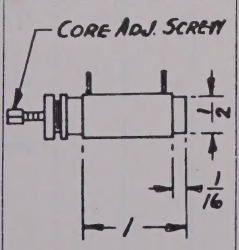
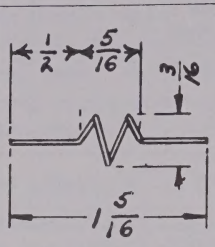
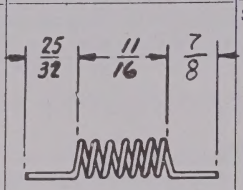
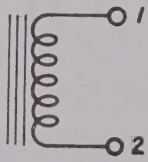
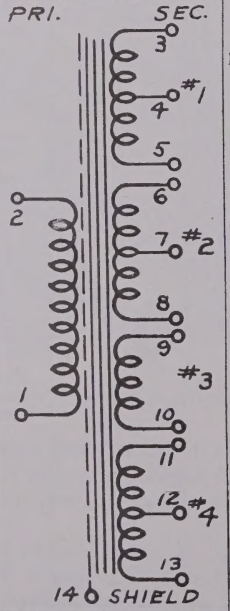
DESIGNATION SYMBOL	FME PART NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D.C. RESIS. OHMS.	HI POT VOLTS	REMARKS
L–101 L–105	302-901		Progressive Universal	No. 39E	121	7.0		35 uh. ± 5%; coated with fungus resistant varnish; unshielded.
L–102	302-902		Single layer wound	No. 20E	26	.04		4.9 uh. ± 10%; powdered iron core tuning; coated with fungus resistant varnish; unshielded.
L–103	302-903		Single layer wound	No. 14E	14	.005		1.3–3 uh. ± 10%; powdered iron core tuning; coated with fungus resistant varnish.

TABLE 5–4. WINDING DATA—Continued

DESIGNATION SYMBOL	FME PART NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D.C. RESIS. OHMS.	HI POT VOLTS	REMARKS
L–104	302-303		Single self-supporting winding	No. 20 hard drawn tinned copper	1½	—		
L–106 L–107	302-363		Single self-supporting winding	No. 18 tinned copper wire	7			⅛" I.D.
L–108	309-904		Single	No. 33PE	4,320	500	1,000 V. A.C. 60 cycles	20 henries at .060 amps. and 100 cps. Test voltage 5 V. A.C. (RMS). Hermetically sealed.
T–101	302-904							**Full load volts ± 2%**
			Primary multi-layer windings two taps	No. 21PE	257		1,750 V. A.C. 50-1000 cycles	115 V. A.C. ±10%
			Sec. No. 1	No. 32PE	1,920CT			410/070
			Sec. No. 2	2 No. 20PE	15CT			**6.3/3.5**
			Sec. No. 3	No. 20PE	12			**5.0/2.0**
			Sec. No. 4	No. 23PE	30CT			12.6/.8
			Shield	.002" brass sheet	1			**Hermetically sealed.**

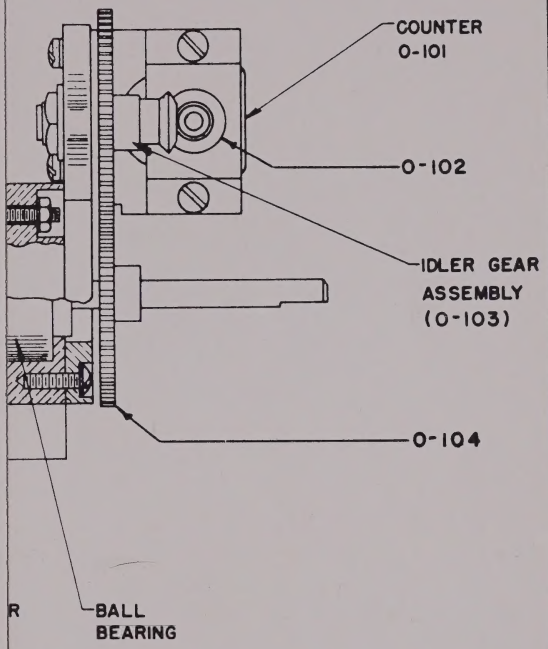
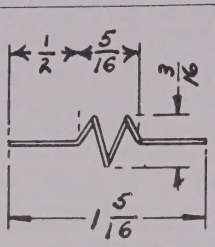
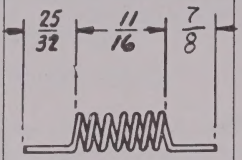
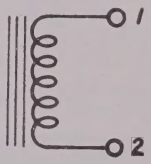
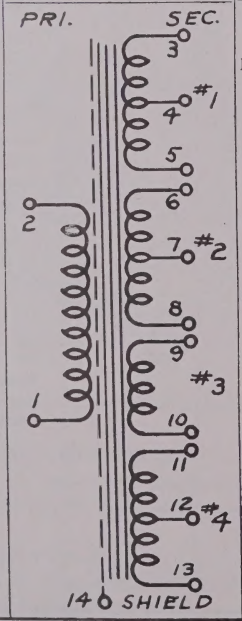


Figure 5–9. Waveguide Tuner Assembly

TABLE 5-4. WINDING DATA—Continued

DESIGNATION SYMBOL	FME PART NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D.C. RESIS. OHMS.	HI POT VOLTS	REMARKS
L-104	302-303		Single self-supporting winding	No. 20 hard drawn tinned copper	1½	—		
L-106 L-107	302-363		Single self-supporting winding	No. 18 tinned copper wire	7			⅛" I.D.
L-108	309-904		Single	No. 33PE	4,320	500	1,000 V. A.C. 60 cycles	20 henries at .060 amps. and 100 cps. Test voltage 5 V. A.C. (RMS). Hermetically sealed.
T-101	302-904							**Full load volts ± 2%**
			Primary multi-layer windings two taps	No. 21PE	257		1,750 V. A.C. 50-1000 cycles	115 V. A.C. ±10%
			Sec. No. 1	No. 32PE	1,920CT			410/070
			Sec. No. 2	2 No. 20PE	15CT			**6.3/3.5**
			Sec. No. 3	No. 20PE	12			**5.0/2.0**
			Sec. No. 4	No. 23PE	30CT			12.6/.8
			Shield	.002" brass sheet	1			**Hermetically sealed.**

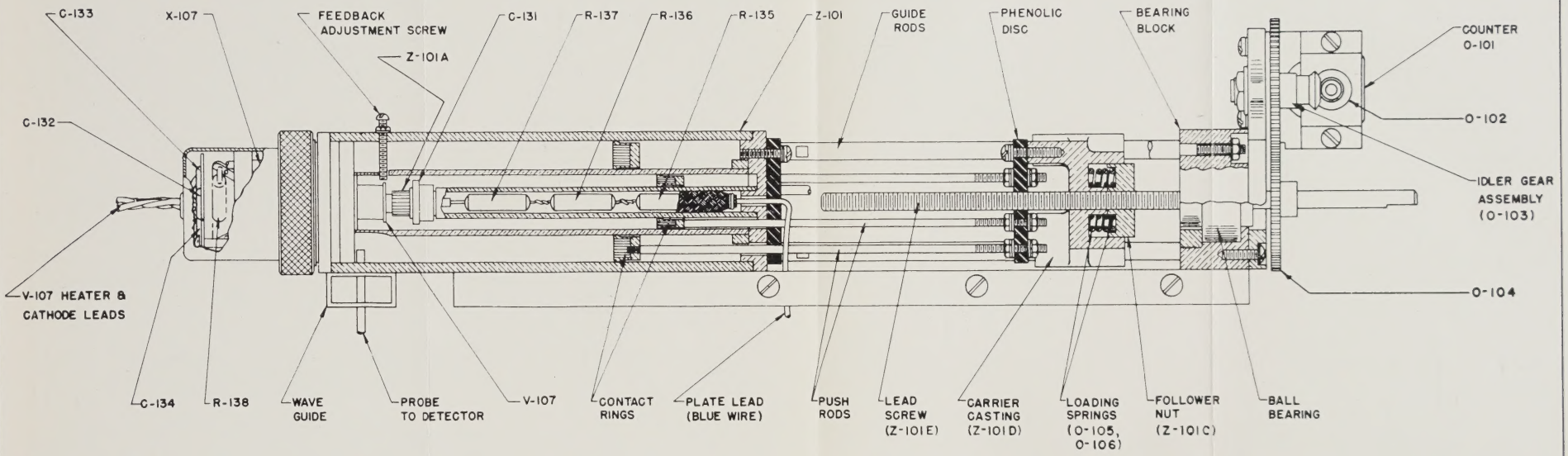
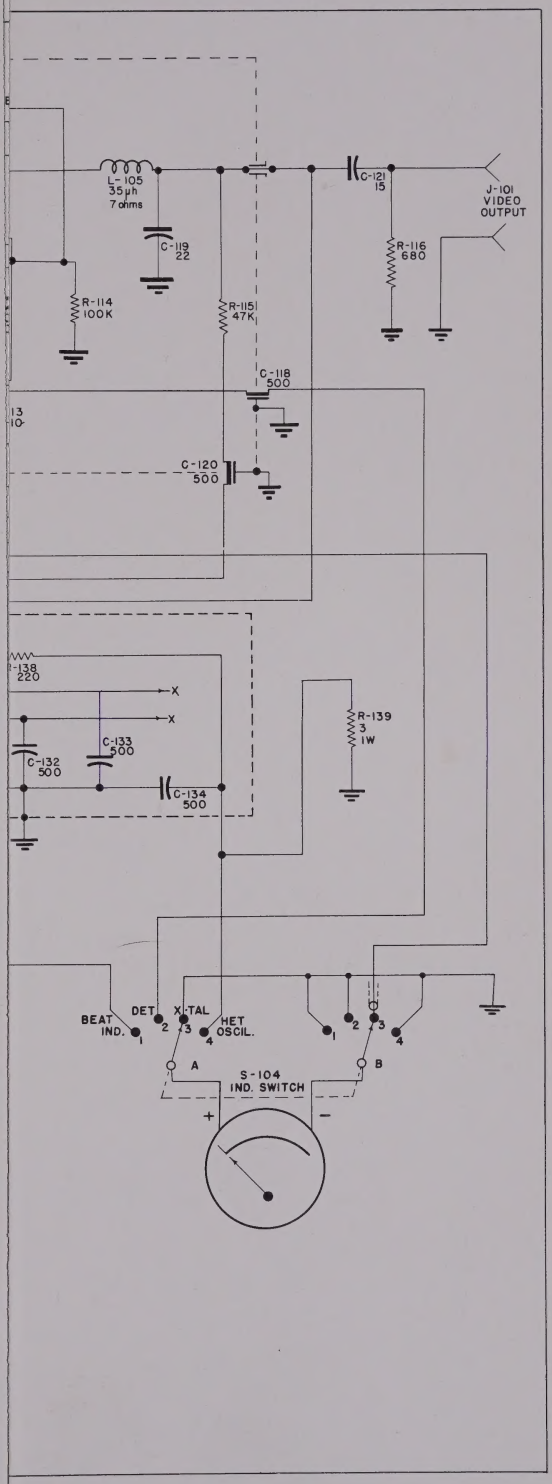


Figure 5-9. Waveguide Tuner Assembly



Schematic Diagram, Frequency Meter TS-186D/UP

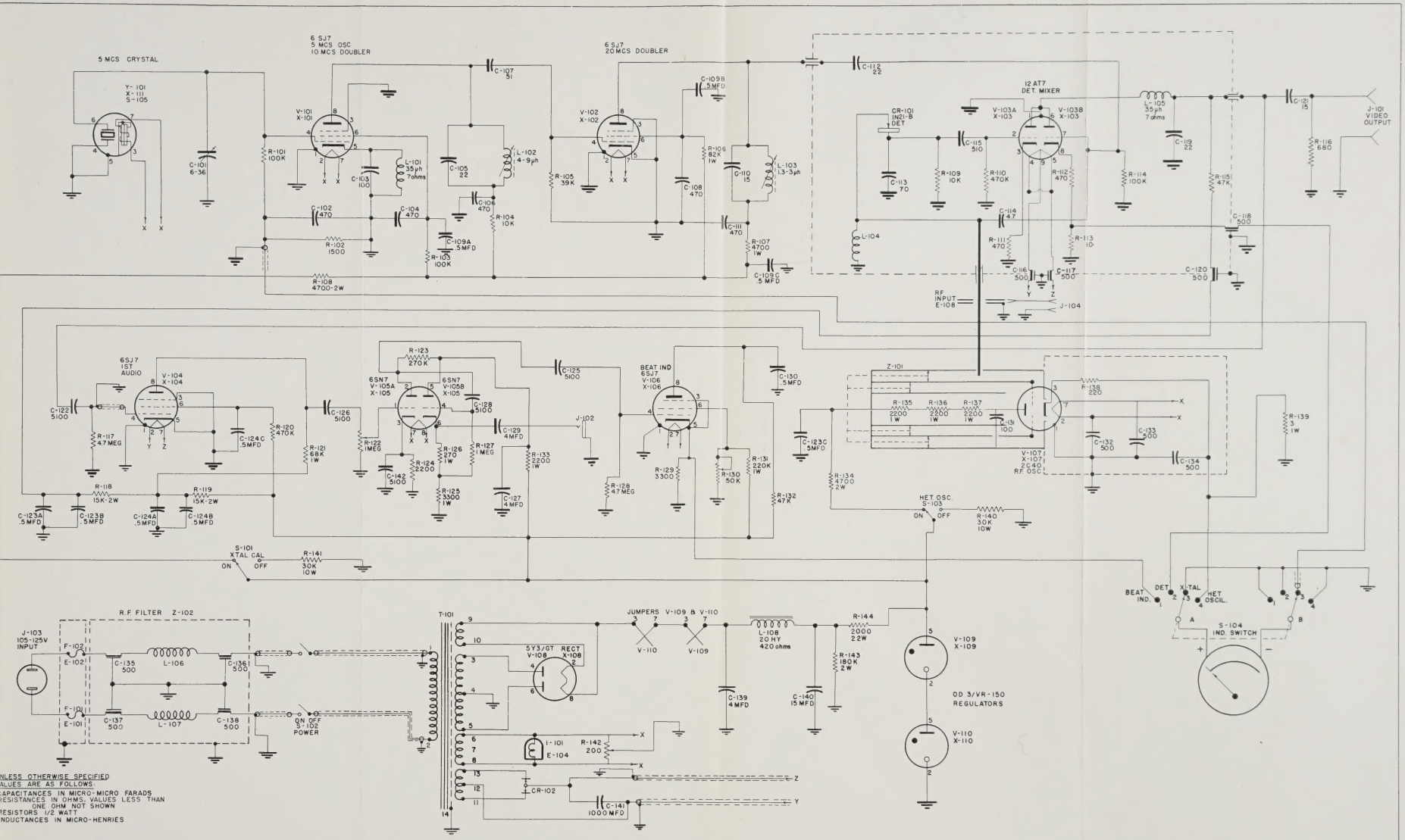
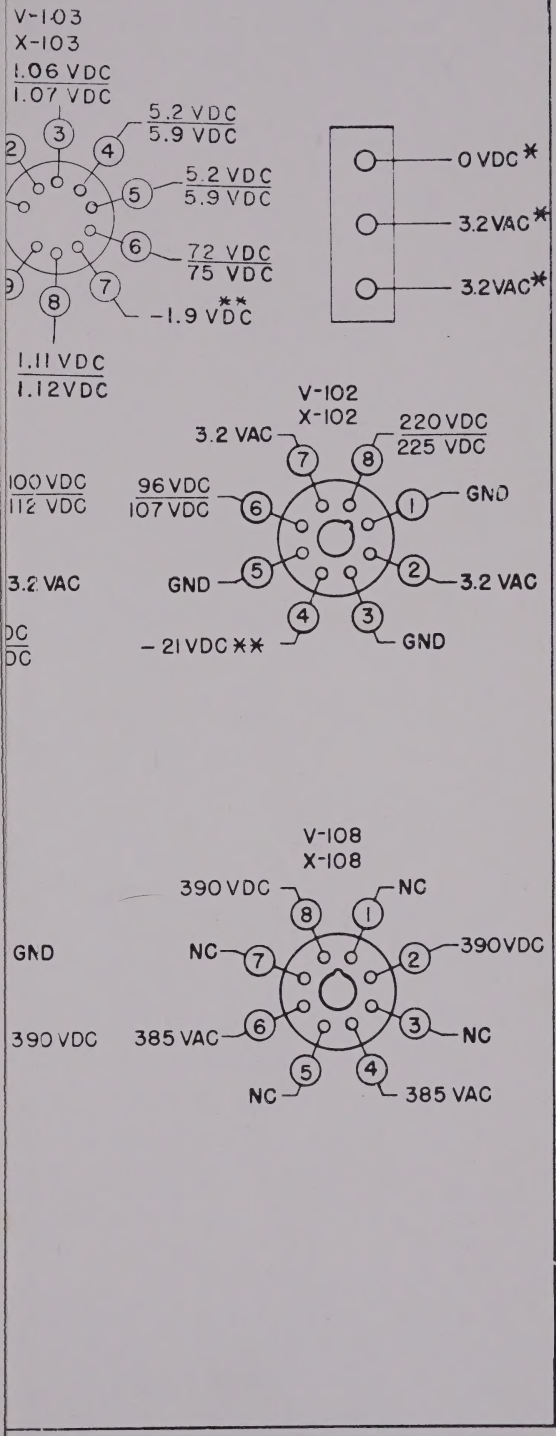
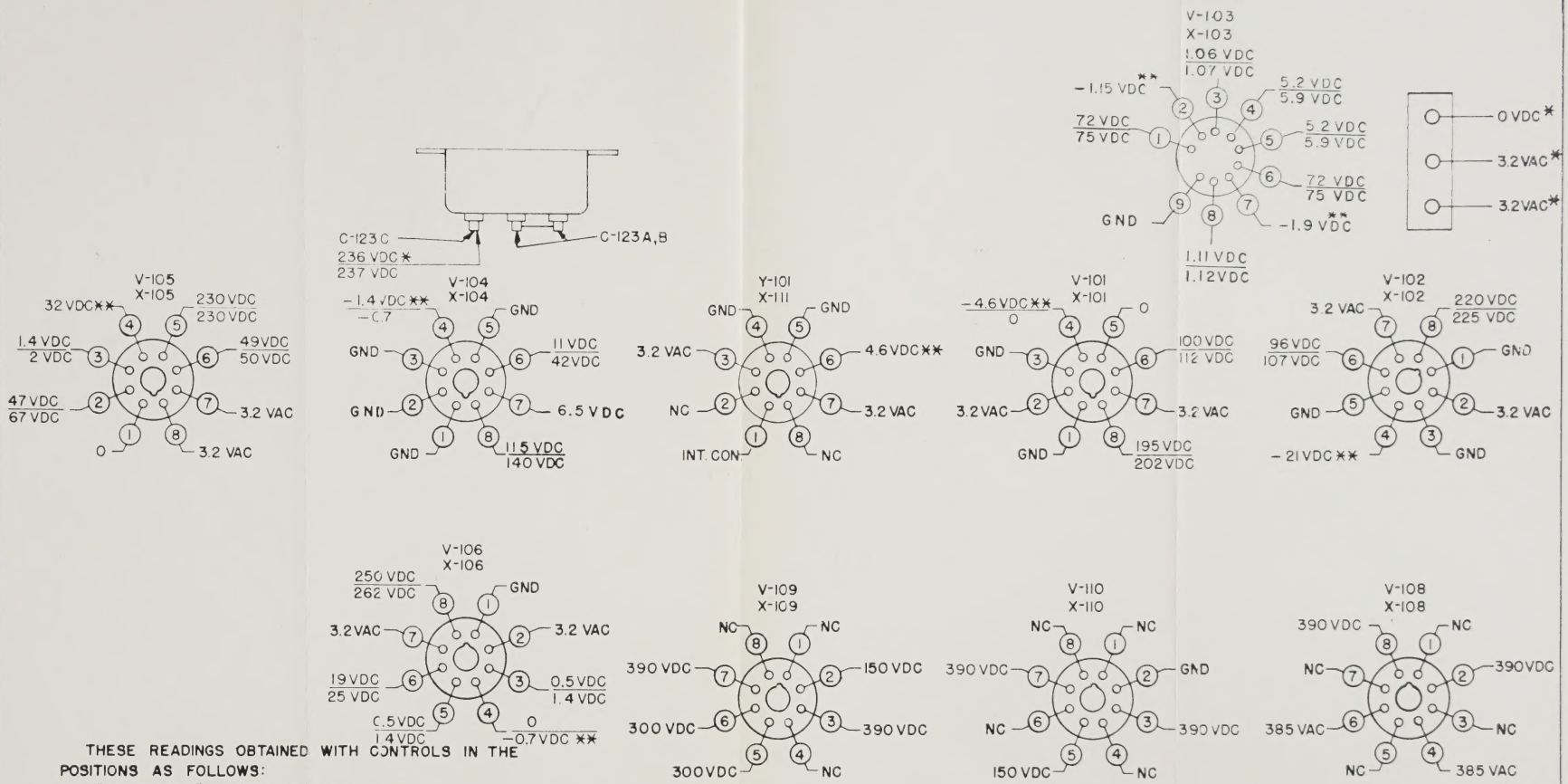


Figure 5-10. Schematic Diagram, Frequency Meter TS-186D/UP


V-103
X-103
1.06 VDC
1.07 VDC
5.2 VDC
5.9 VDC
5.2 VDC
5.9 VDC
72 VDC
75 VDC
-1.9 VDC **
1.11 VDC
1.12 VDC
0 VDC *
3.2 VAC *
3.2 VAC *
V-102
X-102
3.2 VAC
220 VDC
225 VDC
96 VDC
107 VDC
GND
GND
3.2 VAC
- 21 VDC **
GND
V-108
X-108
390 VDC
NC
GND
NC
390 VDC
390 VDC
385 VAC
NC
NC
385 VAC



THESE READINGS OBTAINED WITH CONTROLS IN THE POSITIONS AS FOLLOWS:

"IND. SWITCH" ON "HET. OSC." POSITION.

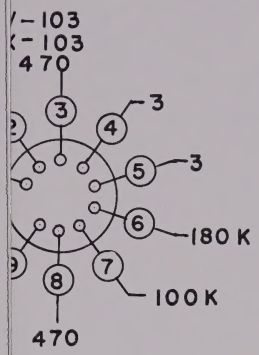
"POWER", "XTAL CAL." AND "HET. OSC." SWITCHES "ON".

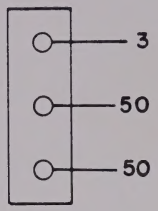
"VOLUME" CONTROL SET AT MAXIMUM.

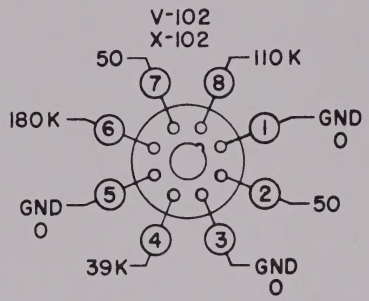
WHERE TWO READINGS ARE SHOWN FOR ONE POINT THE READING ABOVE THE LINE IS FOR A 1000 OHMS-PER-VOLT METER AND THE READING BELOW THE LINE IS FOR A 20,000 OHMS-PER-VOLT METER EXCEPT AS INDICATED BY **
ALL VOLTAGE READINGS MADE TO CHASSIS.
* POTENTIALS FOR V-107 MEASURED AT THESE POINTS

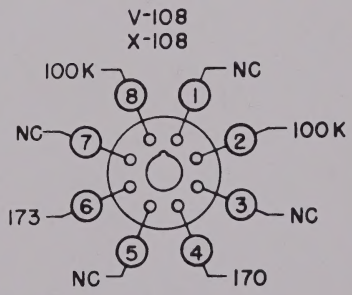
** ELECTRONIC MULTIMETER MEASUREMENTS

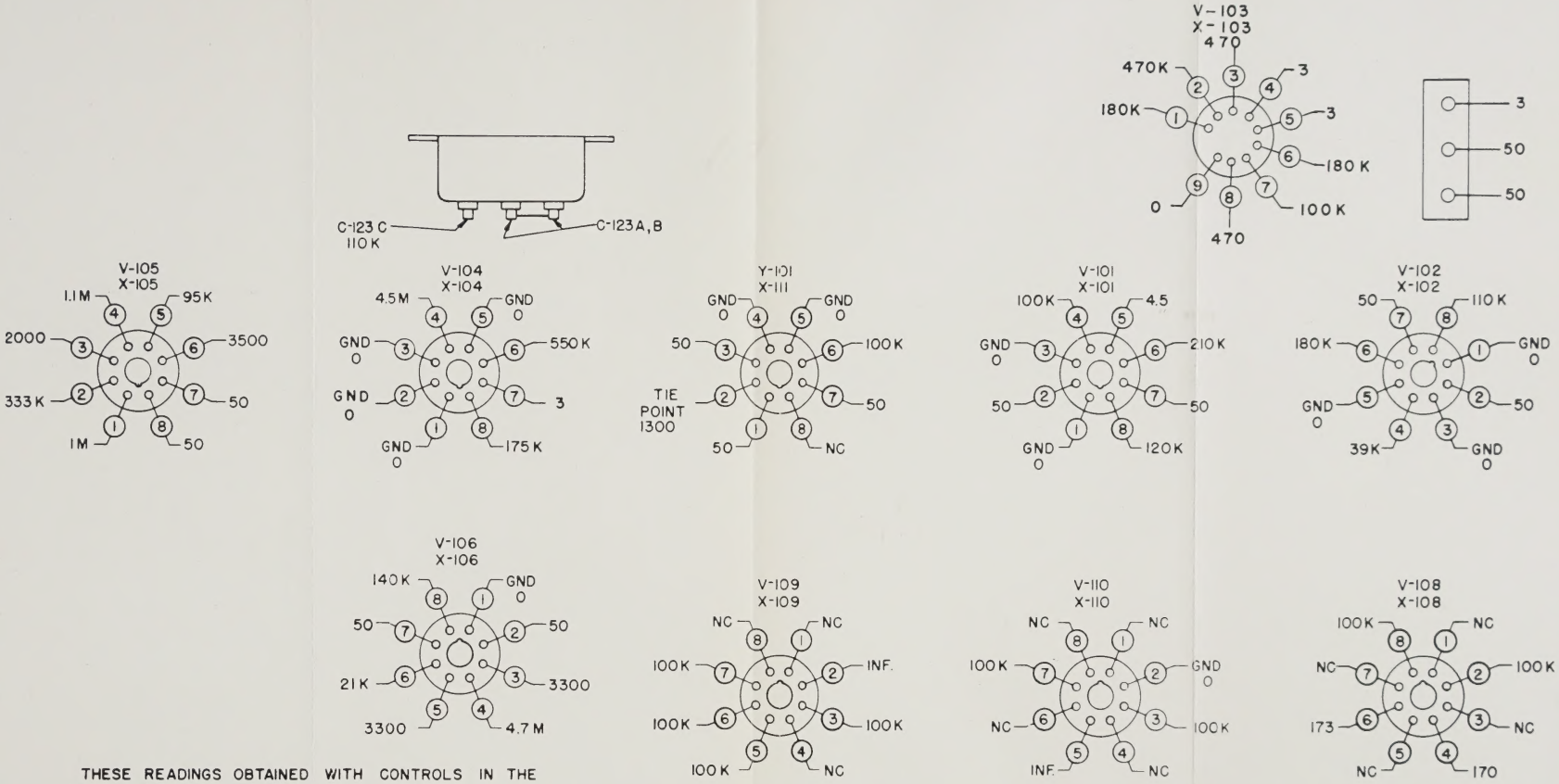
Figure 5-11. Voltage Diagram, Frequency Meter TS-186D/UP


V-103
X-103
470
3
3
180 K
100 K
470


3
50
50


V-102
X-102
50
110 K
180 K
GND
0
GND
0
50
39K
GND
0


V-108
X-108
100K
NC
NC
100K
173
NC
NC
170

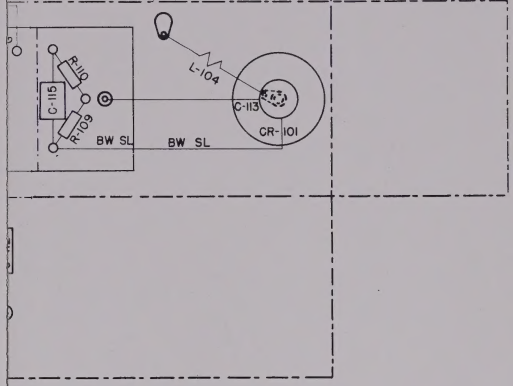


THESE READINGS OBTAINED WITH CONTROLS IN THE POSITIONS AS FOLLOWS:

"IND. SWITCH" ON "HET. OSC." POSITION.
"XTAL. CAL." AND "HET. OSC." SWITCHES "ON"
"VOLUME" CONTROL SET AT MAXIMUM.

ALL RESISTANCE VALUES ARE IN OHMS.
ALL RESISTANCES ARE MEASURED TO CHASSIS.

Figure 5-12. Resistance Diagram, Frequency Meter TS-186D/UP



D
VN
CK
K BLUE
T BLUE
EN
NGE

TE
LOW
20 TINNED COPPER WIRE
B TINNED COPPER WIRE
ELDING
EVING
STIC TUBING

WIRE
UP WIRE No.20 SRIR-JAN-C-76
AS SHOWN

NOTE: SHIELDING
PURCHASE FROM
LENZ ELECTRIC M'FG CO. CHICAGO, ILL.
1/8 WIDE TINNED COPPER BRAIDED
SHIELDING OPENS TO 7/32

NOTE: SLEEVING
PURCHASE FROM
BENTLEY-HARRIS M'FG CO.#20
GRADE B BEN-HAR, SPECIAL TREATED
FIBRE GLASS SLEEVING

NOTE: PLASTIC TUBING
PURCHASE FROM: INDUSTRIAL
SYNTHETICS CORP. IRVINGTON, N.J.
FT-11, CLEAR, .138 I.D. .016 WALL

3. Wiring Diagram, Frequency Meter TS-186D/UP

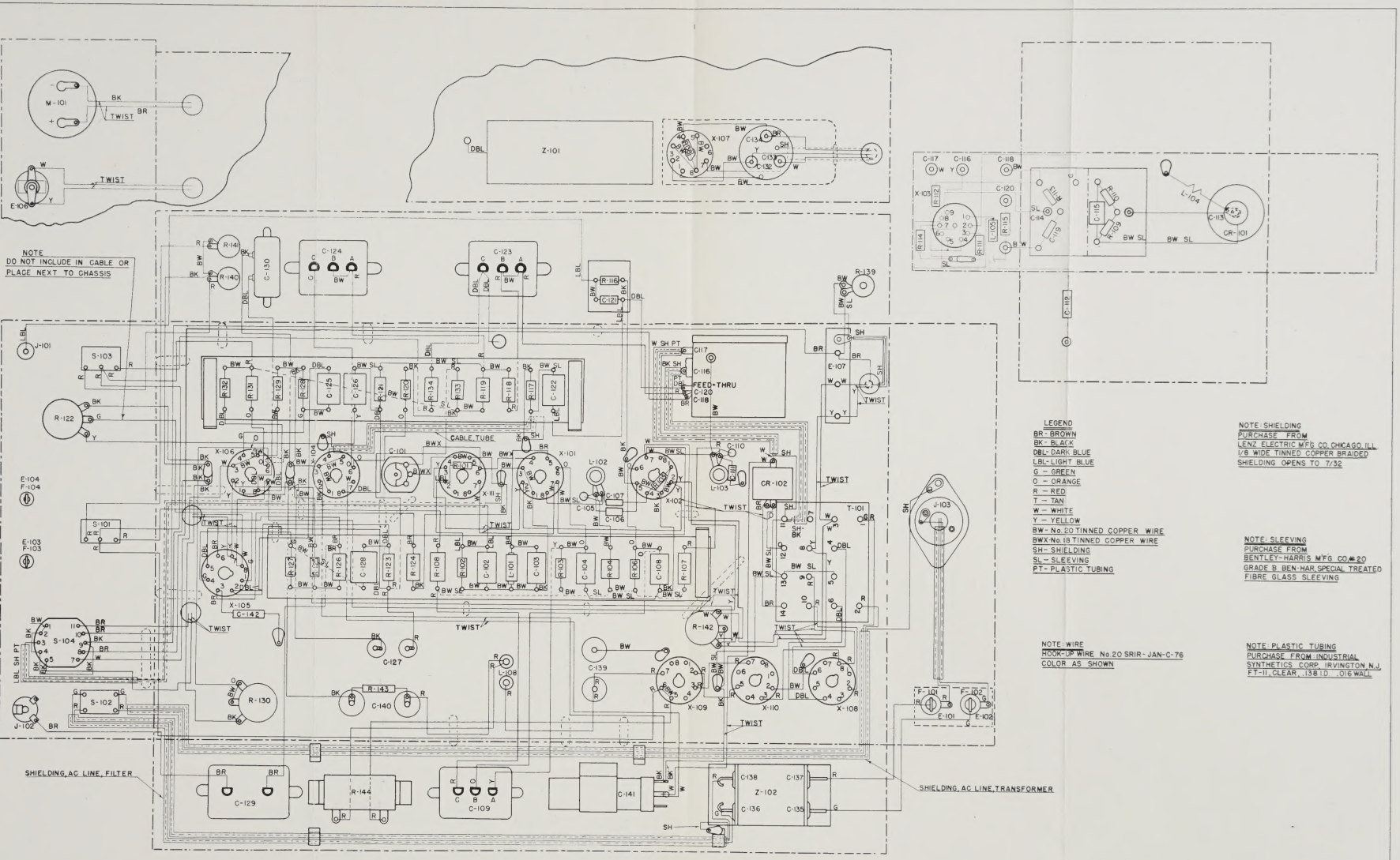

NOTE
DO NOT INCLUDE IN CABLE OR PLACE NEXT TO CHASSIS
FEED-THRU
CABLE, TUBE
SHIELDING, AC LINE, FILTER
SHIELDING, AC LINE, TRANSFORMER
LEGEND
BR - BROWN
BK - BLACK
DBL - DARK BLUE
LBL - LIGHT BLUE
G - GREEN
O - ORANGE
R - RED
T - TAN
W - WHITE
Y - YELLOW
BW - No. 20 TINNED COPPER WIRE
BWX - No. 18 TINNED COPPER WIRE
SH - SHIELDING
SL - SLEEVING
PT - PLASTIC TUBING
NOTE: SHIELDING PURCHASE FROM LENZ ELECTRIC MFG. CO. CHICAGO, ILL. 1/8 WIDE TINNED COPPER BRAIDED SHIELDING OPENS TO 7/32
NOTE: SLEEVING PURCHASE FROM BENTLEY-HARRIS MFG. CO. #20 GRADE B BEN-HAR SPECIAL TREATED FIBRE GLASS SLEEVING
NOTE: WIRE HOOK-UP WIRE No. 20 SRIR-JAN-C-76 COLOR AS SHOWN
NOTE: PLASTIC TUBING PURCHASE FROM: INDUSTRIAL SYNTHETICS CORP. IRVINGTON, N.J. PT-11, CLEAR, .138 I.D. .016 WALL

Figure 5-13. Wiring Diagram, Frequency Meter TS-186D/UP

SECTION 6

COMBINED PARTS AND REPAIR PARTS LISTS

CAUTION

Navy stock numbers in this parts list have been set in two lines because of the length of the stock number and the restricted column space. Be certain that the complete stock number is used when ordering parts. The Signal Corps stock number is enclosed in parenthesis and appears below the Navy stock number. The AAF stock numbers appear below the Signal Corps stock numbers.

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
			CAPACITORS					
C-101	CAPACITOR, variable; air dielectric; plate meshing type; single section; 6-36 mmfd; SLC characteristic; 1-3/8" lg x 31/32" wd x 1" h; screw driver adjustment with locking device; 17 silver plated brass plates; 360 degree rotation; ceramic insulation; lug terminals; two 1/8" lg mtg studs tapped 4-40 on 21/32" mtg/C.	Trimmer for crystal Y-101	484741	N16-C-59504-7993 (3D9036V-8) 3330-313374211	1 ATR-5	CPV-1	C-101	1
C-102	CAPACITOR, fixed: mica; 470 mmfd ± 10%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" tk; axial leads.	V-101 cathode RF bypass	CM20B471K	N16-C-30114-4276 (3K2047121) 3330-376034800	2	CPM-288	C-102 C-104 C-108	3
C-103	CAPACITOR, fixed: silvered mica; 100 mmfd ± 5%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" tk; axial leads.	V-101 5 mc cathode tank capacitor	CM20C101J	N16-C-28653-1201 (3K2010132) 3330-376002800	2	CPM-222	C-103	1
C-104	Same as C-102.	V-102 screen RF bypass						
C-105	CAPACITOR, fixed: ceramic; 22 mmfd ± 5%; 500 vdcw; 0.812" lg x 0.250" diam; axial leads.	V-101 10 mc plate tank capacitor	CC26LH220J	N16-C-16146-6628 (3D9022-14) 3330-313174262	3	CPC-227	C-105 C-119	2
C-106	CAPACITOR, fixed: silvered mica; 470 mmfd ± 5%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" tk; axial leads.	V-101 B+ RF bypass	CM20C471J	N16-C-30109-3801 (3K2047132) 3330-376035600	2	CPM-238	C-106 C-111	2
C-107	CAPACITOR, fixed: silvered mica; 51 mmfd ± 5%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" tk; axial leads.	V-101 output coupling	CM20C510J	N16-C-27656-2601 (3K2051032) 3330-376036600	2	CPM-215	C-107	1
C-108	Same as C-102.	V-102 screen RF bypass						

C-109	CAPACITOR, fixed: paper; 3 section; 500,000 - 500,000 - 500,000 mmfd +40%-15%; 600 vdcw per section; 2" lg x 2" wd x 1-1/4" h; top lug terminals.		CP54B5FF504X	N16-C-54622-3641 (3DA500-773) 3330-319001346	4	CPP-104	C-109A C-109B C-109C C-123A C-123B C-123C C-124A C-124B C-124C	3
C-109A	CAPACITOR, fixed: 500,000 mmfd; part of C-109.	V-101 B+ audio bypass						
C-109B	CAPACITOR, fixed: 500,000 mmfd; part of C-109.	V-102 screen audio bypass						
C-109C	CAPACITOR, fixed: 500,000 mmfd; part of C-109.	V-101, V-102 audio bypass						
C-110	CAPACITOR, fixed: ceramic; 15 mmfd ± 5%; 500 vdcw; 0.562" lg x 0.250" diam; axial leads.	V-102 20 mc plate tank capacitor	CC21LH150J	N16-C-15986-6582 (3D9015-123) 3330-313090661	3	CPC-224	C-110 C-121	2
C-111	Same as C-106.	V-102 plate circuit RF bypass						
C-112	CAPACITOR, fixed: ceramic; 22 mmfd ± 5%; 500 vdcw; 0.562" lg x 0.250" diam; axial leads.	V-102 output coupling capacitor	CC21PH220J	N16-C-16147-1782 (3D9022-43) 3330-313174261	(3) CC21PH220J	CPC-257	C-112	1
C-113	CAPACITOR, fixed: mica dielectric; 70 mmf ± 20%; special consists of dielectric X-112F between X-112D and X-112E.	CR-101 RF bypass		(3D9070-18) 3330-313642126	(5) 302-250, 302-335, 302-334	302-250, 302-335, 302-334	C-113	1
C-114	CAPACITOR, fixed: ceramic; 5 mmf ±.5 mmf; 500 vdcw; 2 axial wire leads; spec JAN-C-20A.	V-107 RF output coupling capacitor to V-103	CC21CK050D	N-16-C-15628-1367 3330-31286088	(3) CC21CK050D	CPC-217	C-114	1
C-115	CAPACITOR, fixed: silvered mica; 510 mmfd ± 5%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" tk; axial leads.	CR-101 RF output coupling capacitor	CM20C511J	N16-C-30188-5001 (3K2051132) 3330-376037400	(2) CM20C511J	CPM-239	C-115	1

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
C-116	CAPACITOR, fixed: silvered mica; 50 mmfd ± 10%; 500 vdcw; silver plated brass housing 1/16" tk x 9/16" lg overall x 29/64" diam; lug terminals.	V-103 filament RF bypass	484493-D10	N16-C-30167-1889 (3D9500-231) 3330-314693504	(3) 370-CB	CPM-500	C-116 C-117 C-118 C-120	4
C-117	Same as C-116.	V-103 filament RF bypass						
C-118	Same as C-116.	V-103 cathode RF bypass						
C-119	Same as C-105.	V-103B plate RF bypass						
C-120	Same as C-116.	V-103B plate lead RF bypass						
C-121	Same as C-110.	J-101 video output coupling capacitor						
C-122	CAPACITOR, fixed: mica; 5100 mmfd ± 5%; 500 vdcw; 54/64" lg x 53/64" wd x 11/32" tk; axial leads.	V-103B audio coupling to V-104	CM35B512J	N16-C-32720-7528 (3K3551222) 3330-376152400	2	CPM-175	C-122 C-125 C-126 C-128 C-142	5
C-123	Same as C-109.							
C-123A	Same as C-109A.	B+ decoupler						
C-123B	Same as C-109B.	B+ decoupler						
C-123C	Same as C-109C.	V-107 plate circuit audio bypass						
C-124	Same as C-109.							
C-124A	Same as C-109A.	B+ decoupler						

C-124B	Same as C-109B.	B+ decoupler						
C-124C	Same as C-109C.	V-104 screen audio bypass						
C-125	Same as C-122.	V-105A audio output coupling.						
C-126	Same as C-122.	V-104 audio output coupling						
C-127	CAPACITOR, fixed: paper 4.0 mmfd +40-15%; 600 vdcw; 2-1/2" lg x 1-3/16" wd x 3-7/8" h; bottom lug terminals.	V-105B plate audio bypass	CP70B1EF405X	N16-G-49997-8300 (3DB4-242) 3330-317642979	4	CPP-102	C-127 C-139	2
C-128	Same as C-122.	V-105A audio coupling to V-105B						
C-129	CAPACITOR, fixed: paper 4.0 mfd ± 10%; 100 vdcw; 2" lg x 2" wd x 1-1/8" h; top lug terminals.	J-102 audio output coupling	CP54B1EB405K	N16-C-49948-9361 (3DB4-353) 3330-317643096	4	CPP-101	C-129	1
C-130	CAPACITOR, fixed: paper; 500,000 mmfd +40-15%; 600 vdcw; 1-13/16" lg x 1" wd x 7/8" h; side lug terminals.	V-106 plate audio bypass	CP53B1FF504X	N16-C-47335-7210 (3DA500-772) 3330-319001345	4	CPP-103	C-130	1
C-131	CAPACITOR, fixed: mica dielectric; 100 mmfd ± 20%; 500 vdcw; 1/2" OD x 0.140" ID x .0015" thk; surface contact made to gold plated outer surfaces.	V-107 plate RF coupling		N16-C-28546-8800 (3D9100-281) 3330-314693008	(5) 302-193	302-193	C-131	1
C-132	CAPACITOR, fixed: silvered mica; 500 mmfd ± 10%; 500 vdcw; silver plated brass housing 1/16" tk; 9/16" lg overall x 29/64" diam; lug terminals.	V-107 filament RF bypass	483330-10	N16-C-30167-1867 (3D9500-230) 3330-314693503	(3) 370-CH	CPM-501	C-132 C-133 C-134 C-135 C-136 C-137 C-138	7
C-133	Same as C-132.	V-107 filament RF bypass						
C-134	Same as C-132.	V-107 cathode RF bypass						

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
C-135	Same as C-132 (P/O Z-102).	AC line RF by-pass						
C-136	Same as C-132 (P/O Z-102).	AC line RF by-pass						
C-137	Same as C-132 (P/O Z-102).	AC line RF by-pass						
C-138	Same as C-132 (P/O Z-102).	AC line RF by-pass						
C-139	Same as C-127.	Power supply B+ filter						
C-140	CAPACITOR, fixed: paper, 10 mf + 40-15%; 600 vdcw; 3-3/4" lg x 1-1/4" wd x 4-3/4" h; 2 bottom post screw term; 1-3/8" h, spaced 2" c to c; spec JAN-C-25.	Power Supply B+ filter	CP70E1DF106X	---------- ---------- 3330-317643359	(2) CP70E1DF106X	CPP-152	C-140	1
C-141	CAPACITOR, fixed: electrolytic; 1000 mfd + 100% -10%; 15 vdcw; 2-3/4" h x 1-3/8" dia; 2 solder term; spec JAN-C-62.	DC filament supply filter	CE31C102E	N16-C-20879-7151 ---------- ----------	(2) CE31C102E	CPE-25	C-141	1
C-142	Same as C-122	V-105A cathode bypass						
	MISCELLANEOUS ELECTRICAL PARTS							
E-101	HOLDER, fuse: finger operated; for type 3AG fuse.	Holds line fuse F-101		N17-F-74267-5701 (3Z3285-6.6) 8870-619703	(8) HKM-H	HOF-4	E-101 E-102 E-103 E-104	4
E-102	Same as E-101.	Holds line fuse F-102						
E-103	Same as E-101.	Spare fuse-holder						

E-104	Same as E-101.	Spare fuse-holder						
E-105	Not used.							
E-106	RECEPTACLE, pilot lamp: red jewel bayonet base.	Holds pilot lamp		N17-L-76854-3973 (2Z5991) 8800-529196	(9) 50	REC-1	E-106	1
* E-107	BOARD, terminal: general purpose; 3 silver plated brass pillar terminals; 1/2" spacing between terminals; laminated phenolic 2-1/4" lg x 3/4" wd x 3/32" tk; two .154" diam holes on 1-3/4" mtg/C.	Tie points		N17-B-77586-6736 (3Z770-3.37)	(5) 302-390	302-390	E-107	1
E-108	WAVEGUIDE: Army-Navy type RG-52/U; with end plate for adapter (J-104); 1-3/4" lg x 1-3/4" wd x .093" tk; four .250" diam holes on 1-9/32" x 1-7/32" centers counterbored 5/16" diam x 1/32" deep; silver plated brass; range 8000-10,000 mc; 2-11/32" lg x 1-3/4" wd x 2" h overall; mounts by four #6-32 stop nut fasteners on bracket attached to waveguide on 1-5/8" mtg/C.	RF input from J-104		N16-W-21991-1324 (2Z4885-206) 3300-291643505	(5) 302-280	302-280	E-108	1
E-109	SHIELD, electron tube: copper nickel pltd; cylindrical, open top; twist lock mtg to socket saddle; 1-1/2" lg x .350" diam less flange piece; with compression spring spec JAN-S-28A.	Tube shield for V-103	TSFOT104	N16-S-34532-8725 (2Z8304-180) 3300-295579003		SHT-7	E-109	1
E-110	KNOB: bar; black bakelite; for 1/4" diam shaft; one #8-32 set screw, white marking; 1-1/8 lg x 3/4" wd x 5/8" h; brass insert; shaft hole 1/2" deep.	IND SWITCH knob		N16-K-700065-901 (2Z5838) 3300-292266000	(30) SO292-3L	KNB-107	E-110 E-111	2
E-111	Same as E-110.	VOLUME control knob						

* Not furnished as a maintenance part. If failure occurs do not request replacement unless the item cannot be repaired or fabricated.

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
F-101	FUSE: 2.0 ampere; 250 volt; 3 AG; 1/4" diam x 1-1/4" lg.	Line fuse	-28032-2	N17-F-16302-100 (3Z1927) 8800-360982	(8) 3AG-2	FUS-12	F-101 F-102 F-103 F-104	4
F-102	Same as F-101.	Line fuse						
F-103	Same as F-101.	Spare						
F-104	Same as F-101.	Spare						
			HARDWARE					
H-101	CLAMP, electron tube: stainless steel; round, closes to 1-1/4" diam; single mtg leg 1/2" h with oblong mtg hole 3/16" w x 5/16" lg locking flange 1/8" wd; 1/4" from mtg hole center.	Clamps V-101, V-102, V-104, V-105, V-106, V-108	491822	N16-C-301009-715 (2Z2643.103) 3300-287	(10) 926B-31	CLA-5	H-101	6
H-102	CLAMP, Electron tube; stainless steel; round, closes to 1-1/8" diam; single mtg leg 3/4" h with oblong mtg hole 3/16" w x 5/16" lg, locking flange 1/8" wd x 1/4" from mtg hole center.	Clamps V-109, V-110	-49496	N16-C-300798-396 (2Z642.82) 3300-287178302	(10) 926A-14	CLA-4	H-102	2
H-103	WRENCH, Allen type: hexagonal; for #4 set screw; long arm 1-3/4" lg, short arm 1/2" lg, 3/64" across flats; nitrided steel.	Set screw wrench		41-W-2444 (6R55499) 7900-859460	11	WRE-3	H-103	1
H-104	WRENCH, Allen type: hexagonal; for #6 set screw; long arm 1-3/4" lg, short arm 9/16" lg, 1/16" across flats; nitrided steel.	Set screw wrench		41-W-2445 (6R57400-6) 7900-859480	11	WRE-1	H-104	1

H-105	WRENCH, Allen type: hexagonal; for #8 set screw; long arm 2" lg, short arm 11/16" lg, 5/64 across flats; nitrided steel.	Set screw wrench		41-W-2446 (6R57400) 7900-859490	11	WRE-4	H-105	1
H-106	WRENCH, Allen type: hexagonal; for #10 set screw; long arm 2-3/8" lg, short arm 13/16" lg, 3/32" across flats; nitrided steel.	Set screw wrench		41-W-2449-25 For replacement use G41-W-2449 (6R55496.1) 7900-859500	11	WRE-5	H-106	1
H-107	WRENCH, spanner 0.922" c/c of pins; 5" lg x 1/2 wd x 1/8" tk; cold rolled steel body with drill rod pins; flat straight handle.	Fits V-107 shield locking ring		N41-W-3247-687 or 41-W-99500-7 (6R57501-2) 8042-302-603A	(5) 302-603	302-603	H-107	1
H-108	WRENCH, spanner: 0.540" between pins; tubular shape 2-1/2" lg x 5/8" OD x 0.540" ID; seamless steel tubing; 1/4" diam rod handle.	Fits V-107 plate contact adapter		N41-W-3261-400 or 41-W-99500-6 (6R7522-7) 8042-302-604A	(5) 302-604	302-604	H-108	1
H-109	CLAMP, electrical: aluminum, satin finish; 1-15/16" lg x 1-1/2" w x 23/32" h o/a; mts by two 5/32" dia holes on 7/8" mtg C.	Clamps capacitor C-141			(5) CLA-84	CLA-84	H-109	1
			INDICATORS					
I-101	LAMP, incandescent, 6-8 v., 0.15 amp; bulb T-3-1/4 clear, 1-1/8" lg overall; miniature bayonet base; tungsten filament; burn any position.	Power indicator		17-L-6297 (2Z5952) 8800-444163	(12) Mazda #47	LAI-1	I-101	1
			JACKS AND RECEPTACLES					
J-101	CONNECTOR, female contact; one round female contact; straight type; 11/16" lg x 5/8" barrel diam, 1" sq mtg flange; nonconstant frequency impedance characteristic; cylindrical body with square mtg flange, die case zinc shell silver plated; four mtg holes in flange, 1/8" diam in square 23/32" c/c.	Video output	49194	N17-C-73108-5890 (2Z8799-239) 8850-667760	(13) 83-1R	CON-12	J-101	1

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND NAVY TYPE NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
J-102	JACK, telephone; for two-cond. 0.25" diam plug; 1-9/64" lg x 3 4" diam excluding terminals; J1-1A contact arrangement; 3/8-32 threaded bushing; one nickel plated plain washer and hex mtg nut; mtg hole 25/64" diam.	Audio output	JJ034	N17-J-39248-4413 (2Z5534) 8850-749430	(7) SC-1A	JAT-1	J-102	1
J-103	CONNECTOR, receptacle; two male rectangular contacts; straight type; 1.531" h x 1.593" diam, 2-1/2" lg mtg flange; 250 volts 10 amp, 125 volts 15 amps; cylindrical metal shell, black composition insert; two .203" diam mtg holes 2.062" c/c.	Power input		N17-C-73450-4387 (6Z7816) 8850-495130	(14) 4897	CON-24	J-103	1
J-104	ADAPTER: coaxial to wave guide; coupling loss negligible; one end terminates in a flange and probe; other end terminates in AN receptacle UG-58/U Type N Female; wave-guide cross section 1" x 1/2", 0.050" wall; mates with coaxial plugs UG-18/U or UG-21/U; input and output impedance 50 ohms; overall size 2-13/32" x 1-5/8" x 1-5/8"	RF input		N16-A-15630-7051 (3F2-1) 3300-325004095	(5) 302-760	302-760	J-104	1
			INDUCTORS					
L-101	COIL, RF: 5 megacycle tuning; single layer wound; 121 turns # 39E wire; unshielded; 35.0 microhenries ±5%; 7/32" diam x 5/8" lg; phenolic form 3/16" diam x 5/8" lg; tuned by external fixed capacitor; mounts by connecting leads, each 1-1/2" lg; coated with fungus resistant varnish.	V-101 5 mc cathode tank coil	471253	N16-C-73447-6829 3C1084Z21-11 3340-308415842	(1) 13863	302-901	L-101 L-105	2

L-102	COIL, RF: 10 megacycle tuning; single layer wound; unshielded; 4-9 microhenries ± 10%; 26 turns 20 E wire; 5/8" diam x 2-1/4" lg excluding terminals and adjusting screw; Isolantite form powdered iron core; form 1/2" diam x 1-3/4" lg above mtg bushing; core adjustable by wrench or screw driver from base; mtg bushing molded in base of form, 3/8-32" thread, metal nut; two terminals; coil coated with fungus resistant varnish.	V-101 10 mc plate tank coil	471251	N16-C-76575-8284 (3C1084Z80-1) 3340-310038501	(1) Per Federal Dwg. 302-902	302-902	L-102	1
L-103	COIL, RF: 20 megacycle tuning; single layer wound; unshielded; 1.3-3 microhenries ± 10%; 14 turns # 14E wire; 5/8" diam x 2-1/4" lg excluding terminals and adjusting screw; isolantite form, powdered iron core; form 1/2" diam x 1-3/4" lg above mtg bushings; core adjustable by wrench or screw driver from base; mtg bushing molded in base of form, 3/8-32 thread; metal nut; two terminals; coil coated with fungus resistant varnish.	V-102 20 mc plate tank coil	471252	N16-C-76536-8244 (3C1084Z80) 3340-310038500	(1) Per Federal Dwg. 302-903	302-903	L-103	1
L-104	COIL, RF: UHF choke; single self supporting winding; unshielded; 1-1/2 turns # 20 hard drawn tinned copper wire; 5/16" lg x 3/16" diam excluding leads; no form; mounted by connecting leads each 1/2" lg.	CR-101 RF choke	472433	N16-C-71627-2160 (3C1084Z80-3) 3340-310038503	(5) 302-303	302-303	L-104 L-105	2
L-105	Same as L-101.	V-103B plate RF choke						
L-106	COIL, RF: choke; single; self supporting winding; unshielded; 7 turns #18 tinned copper wire, 1/8" ID x 11/16" lg; no form; mounted by connecting leads, one 25/32" lg, other 7/8" lg (P/O Z-102).	Line filter	472432	N16-C-71892-1062 (3C1084Z80-2) 3340-310038502	(5) 302-363	302-363	L-106 L-107	2
L-107	Same as L-106 (P/O Z-102).	Line filter						

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
L-108	REACTOR: filter choke; 20 henries, 60 milliamperes; 440 ohms DC resistance; test voltage 1500 RMS, 60 cycles; hermetically sealed metal case, 2-15/16" lg x 2-9/16" wd x 3-3/4" h; four 8-32 x 3/8" lg mtg studs on 2" x 1-7/8" mtg/C; two solder lugs on bottom.	Power supply filter			(15) per FME dwg 309-905	309-905	L-108	1
			METERS					
M-101	METER, ammeter: DC D'Arsonval movement; 1.0 m.a. basic movement; scale 0-1 m.a.; self-contained; accuracy ± 2% full scale deflection; round case 2.21" diam x 1.6" deep behind flange; flange diam 2.695"; molded phenolic case.	Indicator	MR25W001DCMA	N17-M-19255-1051 (3F891-20) 3300-325260650	12	MEM-1	M-101	1
			DIALS					
N-101	DIAL, tuning: nickel plated brass; disappearing crank; 2" diam x 1-1/16" deep overall; mounts on 1/4" diam shaft with one #10 Allen type set screw.	Oscillator tuning control		N16-D-46347-3976 (3F30995-1) 3300-328550930	(5) 302-270	302-270	N-101	1
*N-102	PLATE, indicator: fiducial marker for oscillator tuning dial; black anodized aluminum; round; 2-7/32" OD x .562" ID x .193" h; single etched marking on outer edge.	Reference marker for N-101		N16-D-351021-108 (3F33395-1) 3300-32851690	(5) 302-482	302-482	N-102	1

MECHANICAL PARTS

O-101	COUNTER, mechanical: gear drive; metal die casting; black wrinkle finish; 1-15/16" lg x 15/16" wd x 1-5/32" h; three digits; non-reset; clockwise rotation to add; subtracts in opposite direction; max speed 500 RPM; footed "U" bracket mtg.	Indicates revolutions of tuning dial N-101		N18-R-273-9150 (6Z3417-40) 3300-696292533	16	302-144	O-101	1
O-102	GEAR: bevel; natural phenolic LTS-M-3; straight teeth; 16 teeth; 32 pitch, 14-1/2° pressure angle; .542" OD, .125" ID brass insert, 5/16" h; 1/4" ID integral brass insert; mounts by two #4-40 holes spaced 120° apart.	Drives O-101 counter		N16-G-402210-101 (2Z4878-1165) 3300-291632793	(5) 302-143	302-143	O-102	1
O-103	GEAR ASSEMBLY: intermediate Veeder counter drive; one spur gear 96 teeth; approx 2-3/32" OD, one bevel gear 16 teeth approx 1/2" OD; brass; approx 1-5/16" lg x 2-3/32" diam overall; mounts by single 3/8-32 x 33/64" lg bshg.	Intermediate drive for O-101 counter		N16-G-500001-254 (2Z4875-367) 3300-291628371	(5) 302-230	302-230	O-103	1
O-104	GEAR: spur; natural phenolic LTS-M3; intermediate counter drive; straight teeth; 36 teeth; 48 pitch 2" pitch diam; 2.0416" OD, .250" bore x 3/8" h overall; straight face; .625" OD x .250" ID x 1/4" h hub; mounts by two #6-32 holes at 120° apart.	Intermediate drive for O-101 counter		N16-G-432816-133 (2Z4878-1143) 3300-291632771	(5) 302-241	302-241	O-104	1
O-105	SPRING: helical compression type; tuner antibacklash; .071" diam music wire; 11/16" lg x 1/2" OD; 5 turns; two end hook term.	Antibacklash apring for Z-101D		N17-S-46701-4186 2Z8877.359 ----------	(5) 302-239	302-239	O-105	1
O-106	SPRING: helical compression type; tuner antibacklash; .080" diam music wire; 1" lg x 13/16" OD; 5 turns; two end hook term.	Antibacklash spring for Z-101D carrier		N17-S-46658-4601 (2Z8877.360) ----------	(5) 302-258	302-258	O-106	1
O-107	MOUNTING: aluminum; holds clamp H-109 and mts to chassis by two each #6-32 holes on 7/8" mtg C.	Mounts H-109 to chassis			(5) PLA-26	PLA-26	O-107	1

* Not furnished as a maintenance part. If failure occurs do not request replacement unless the item cannot be repaired or fabricated.

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
P-101	CONNECTOR, plug: two "T" shaped female cont; straight type; 1-35/64" diam x 1-5/16" h o/a excluding cable clamp; cont rated 10 amp at 250 v; 15 amp at 125 v; cylindrical steel body, cad pl; composition insert; opening for 0.562" diam cable; has cable clamp in top.	W-101 front panel plug	491077	N17-B-21892-30 (6Z3150-5) 8850-212240	(14) 7084	CON-13	P-101	1
P-102	CONNECTOR, plug: two parallel blade male cont; straight type; 1-17/32" diam x 5/8" h o/a excluding term and cable clamp cont rated 10 amp at 250 v, 15 amp at 125 v, cylindrical steel body; bakelite insert; opening for .562" diam cable.	W-101 AC line plug	49825	N17-C-71426-2729 (6Z1727) (4T99358) 8850-221175	(14) 7057	CON-14	P-102	1
			RESISTORS					
R-101	RESISTOR, fixed: composition; 100,000 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam, insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-101 grid leak	RC20BF104K	N16-R-50633-811 (3RC20BF104K 3300-381166220	(17) EB	RES-200	R-101 R-103 R-114	3
R-102	RESISTOR, fixed: composition; 1500 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam, insulated humidity and salt water immersion resistant; two axial wire lead terminals.	Meter shunt in Xtal position of S-104	RC20BF152K	N16-R-49967-811 (3RC20BF152K) 3300-381167080	(17) EB	RES-178	R-102	1
R-103	Same as R-101.	V-101 screen dropping resistor						
R-104	RESISTOR, fixed: composition; 10,000 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; (continued)	V-101 plate dropping resistor	RC20BF103K	N16-R-50282-811	(17) EB	RES-188	R-104 R-109	2

	insulated, humidity and salt water immersion resistant; two axial wire lead terminals.			(3RC20BF103K) 3300-381166160				
R-105	RESISTOR, fixed: composition; 39,000 ohms ± 10%; 1/2 watt; F characteristic 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-102 grid leak	RC20BF393K	N16-R-50444-811 (3RC20BF393K) 3300-381169380	(17) EB	RES-195	R-105	1
R-106	RESISTOR, fixed: composition; 82,000 ohms ± 10%; 1 watt; F characteristic; 0.750" lg x 0.280" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-102 screen dropping resistor	RC30BF823K	N16-R-50589-231 (3RC30BF823K) 3300-381321060	(17) GB	RES-499	R-106	1
R-107	RESISTOR, fixed: composition; 4700 ohms ± 10%; 1 watt; F characteristic; 0.750" lg x 0.280" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-102 plate decoupling	RC30BF472K	N16-R-50130-231 (3RC30BF472K) 3300-381319740	(17) GB	RES-484	R-107	1
R-108	RESISTOR, fixed: composition; 4700 ohms ± 10%; 2 watt; F characteristic; 1.41" lg x 0.405" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-101, V-102 plate decoupler	RC40BF472K	N16-R-50130-551 (3RC40BF472K) 3300-381519740	(17) HB	RES-784	R-108 R-134	2
R-109	Same as R-104.	DC return for CR-101						
R-110	RESISTOR, fixed: composition; 470,000 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-103A grid leak	RC20BF474K	N16-R-50822-811 (3RC20BF474K) 3300-381169860	(17) EB	RES-208	R-110 R-120	2
R-111	RESISTOR, fixed: composition; 470 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-103A cathode bias resistor	RC20BF471K	N16-R-49769-811 (3RC20BF471K) 3300-381169680	(17) EB	RES-172	R-111 R-112	2

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
R-112	Same as R-111.	V-103B cathode bias resistor						
R-113	RESISTOR, fixed: wire wound; 10 ohms ± 10%; 1/2 watt; 31/32" lg x 15/64" diam; molded phenolic; resistant to moisture; axial wire leads.	Meter shunt for DET position of S-104	RU3B100K	N16-R-68315-6236 (3RU16003) 3300-384019506	18	RWF-5	R-113	1
R-114	Same as R-101.	V-103B grid leak						
R-115	RESISTOR, fixed: composition; 47,000 ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-103 plate dropping resistor	RC20BF473K	N16-R-50480-811 (3RC20BF473K) 3300-381169800	(17) EB	RES-196	R-115 R-132	2
R-116	RESISTOR, fixed: composition; 680 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	J-101 termination resistor	RC20BF681K	N16-R-49841-811 (3RC20BF681K) 3300-381170520	(17) EB	RES-174	R-116	1
R-117	RESISTOR, fixed: composition; 4.7 meg. ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-104 grid leak	RC20BF475K	N16-R-51173-811 (3RC20BF475K) 3300-38116992	(17) EB	RES-220	R-117 R-128	2
R-118	RESISTOR, fixed: composition; 15,000 ohms ± 10%; 2 watt; F characteristic; 1.41" lg x 0.405" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-103 plate decoupler	RC40BF153K	N16-R-50337-551 (3RC40BF153K) 3300-381517140	(17) HB	RES-790	R-118 R-119	2
R-119	Same as R-118.	V-104 plate decoupler						

R-120	Same as R-110.	V-104 screen dropping resistor						
R-121	RESISTOR, fixed: composition; 68,000 ohms ± 10%; 1 watt; F characteristic; 0.750" lg x 0.280" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-104 plate dropping resistor	RC30BF683K	N16-R-50553-231 (3RC30BF683K) 3300-381320640	(17) GB	RES-498	R-121	1
R-122	RESISTOR, variable: composition; 1.0 meg ± 20%; 1/2 watt; 3 solder lugs; metal case, 1-1/4" diam x 9/16" d; enclosed case; flatted metal shaft, 1/4" diam x 13/16" lg; logarithmic taper; insulated contact arm; without off position; normal torque; 3/8-32 bushing x 3/8" lg, "non-turn" pin located on 17/32" radius at 3 o'clock; no switch.	Audio VOLUME control		---------- ---------- ----------	(17) PT # JA 1052 with FS-3048	RRV-47	R-122	1
R-123	RESISTOR, fixed: composition; 270,000 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-105A plate dropping resistor	RC20BF274K	N16-R-50741-811 (3RC20BF274K) 3300-381168580	(17) EB	RES-265	R-123	1
R-124	RESISTOR, fixed: composition; 2200 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and saltwater immersion resistant; two axial wire lead terminals.	V-105A cathode bias resistor	RC20BF222K	N16-R-50012-811 (3RC20BF222K) 3300-381168060	(17) EB	RES-180	R-124	1
R-125	RESISTOR, fixed: composition; 3300 ohms ± 10%; 1 watt; F characteristic; 0.750" lg x 0.280" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-105B cathode bias resistor	RC30BF332K	N16-R-50067-231 (3RC30BF332K) 3300-381318900	(17) GB	RES-482	R-125	1
R-126	RESISTOR, fixed: composition; 270 ohms ± 10%; 1 watt; F characteristic; 0.750" lg x 0.280" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-105B cathode bias resistor	RC30BF271K	N16-R-49689-231 (3RC30BF271K) 3300-381318440	(17) GB	RES-469	R-126	1

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
R-127	RESISTOR, fixed: composition; 1.0 meg ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-105B grid leak	RC20BF105K	N16-R-50975-811 (3RC20BF105K) 3300-381166280	(17) EB	RES-212	R-127	1
R-128	Same as R-117.	V-106 grid leak						
R-129	RESISTOR, fixed: composition; 3300 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-106 cathode bias resistor	RC20BF332K	N16-R-50066-811 (3RC20BF332K) 3300-381168900	(17) EB	RES-182	R-129	1
R-130	RESISTOR, variable: composition; 50,000 ohms ± 10%; 2 watt; 3 solder lugs; metal case 1-1/4" diam x 9/16" deep; enclosed case, round metal shaft 1/4" diam with screw driver slot 5/8" lg from mtg surface; linear taper; insulated contact arm; without off position; normal torque; shaft locking device; 3/8-32 mtg bushing 1/2" lg; "non-turn" pin located on 17/32" radius at 3 o'clock on switch.	Beat indicator adjustment		N16-R-87849-3860 (377450-136) 3300-399809081	(17) JLU5031	RRV-48	R-130	1
R-131	RESISTOR, fixed: composition; 220,000 ohms ± 10%; 1 watt; F characteristic; 0.750" lg x 0.280" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-106 screen dropping resistor	RC30BF224K	N16-R-50715-231 (3RC30BF224K) 3300-381318180	(17) GB	RES-504	R-131	1
R-132	Same as R-115.	V-106 plate dropping resistor						
R-133	RESISTOR, fixed: composition; 2200 ohms ± 10%; 1 watt; F characteris- (continued)	V-105 plate dropping	RC30BF222K	N16-R-50013-231	(17) GB	RES-480	R-133 R-135	4

	tic; 0.750" lg x 0.280" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	resistor		(3RC30BF222K) 3300-381318060			R-136 R-137	
R-134	Same as R-108.	V-107 plate load resistor						
R-135	Same as R-133.	V-107 plate load resistor						
R-136	Same as R-133.	V-107 plate load resistor						
R-137	Same as R-133.	V-107 plate load resistor						
R-138	RESISTOR, fixed: composition; 220 ohms ± 10%; 1/2 watt; F characteristic; 0.468" lg x 0.249" diam; insulated, humidity and salt water immersion resistant; two axial wire lead terminals.	V-107 cathode bias resistor	RC20BF221K	N16-R-49661-811 (3RD20BF221K) 3300-381168000	(17) EB	RES-168	R-138	1
R-139	RESISTOR, fixed: wire wound; non-inductive; 3.0 ohms ±1%; 1/2 watt 27/32" diam x 15/16" lg; ceramic form; winding coated with high temperature varnish; 2 solder lug term; mtg hole through center clearance for #6 screw; spec JAN-R-93.	Meter shunt for HET OSC position of S-104	RB12B3R00F	---------- ---------- ----------	(18)	RWF-24	R-139	1
R-140	RESISTOR, fixed: wire wound; 30,000 ohms ±5%; 10 watt at 25° C in free space; not tapped; 23/32" diam x 1.0" lg; enclosed in ceramic tube, resistant to humidity; two radial solder lug terminals.	Power supply dummy load for OFF position of S-103	637270-5	N16-R-66523-2701 (3Z6630-117) 3300-392874926	(19) 10VD	RWF-3	R-140 R-141	2
R-141	Same as R-140.	Power supply dummy load for OFF position of S-101						

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
R-142	RESISTOR, variable: wire wound; 200 ohms ± 10%; 2 watt; 3 solder lug terminals; closed metal case 1-1/4" diam x 5/8" deep; round metal shaft, 1/4" dia x 1/2" lg from mtg face, screwdriver slot, linear taper; insulated contact arm without off position, high torque 3/8-32 bushing 3/8" lg.	Filament supply HUM adjustment	RA20A2SA201AK	N16-R-90298-5400 (3RA4214) 3300-380042140	20	RRW-1	R-142	1
R-143	RESISTOR, fixed: composition; 180,000 ohms ± 10%; 2 watt; F characteristic; 1.41" lg x 0.405" diam, insulated, humidity and salt water immersion resistant, two axial wire lead terminals.	Power supply bleeder	RC40BF184K	N16-R-50697-551 (3RC40BF184K) 3300-381517680	(17) HB	RES-803	R-143	1
R-144	RESISTOR, fixed: wire wound; 2000 ohms ± 5%; 22 watt at 25° C in free space; 2-1/32" lg x 1-3/16" wd x 7/16" tk; cement coating, resistant to salt water immersion; two solder lug terminals; integral mtg bracket on 2-3/4" mtg/C.	Power supply voltage regulating resistor	RW21D202	N16-R-66104-4206 (3RW24364) 3300-385243640	18	RWF-17	R-144	1
			SWITCHES					
S-101	SWITCH, toggle: S.P.D.T.; 3 amp, 125 vac; bakelite body; 1-9/32" lg x 23/32" wd x 23/32" d; bat handle 11/16" lg; solder lug terminals; single hole mtg bushing 15/32-32 thread, 15/32" lg; spec JAN-S-23.	XTAL CAL ON-OFF	ST12D	N17-S-72018-7719 (3Z9863-12D) 3360-395852810	(21) 82303B	SWT-3	S-101 S-103	2
S-102	SWITCH, toggle: D.P.S.T.; 3 amp, 125 vac; bakelite body; 1-9/32" lg x 23/32" wd x 23/32" d; bat handle 11/16" lg; solder lug terminals; single hole mtg bushing 15/32"-32 thread, 15/32" lg; spec JAN-S-23.	POWER ON-OFF	ST22K	N17-S-73082-9028 (3Z9863-22K) 3360-395853000	(21) 82304BA	SWT-1	S-102	1

S-103	Same as S-101.	HET OSC ON-OFF						
S-104	SWITCH, rotary: 2 pole, 4 positions; solid silver contacts; phenolic wafer; 25/32" diam x 1-7/16" deep; non-shorting contacts; solder lug terminals; single hole mtg bushing 3/8"-32, 3/8" lg; flatted stainless steel shaft, 1/4" diam x 13/16" lg; retaining "C" washer, other metal parts nickel plated brass.	Meter switch		---------- (3Z9825-62.492) 3360-395499584	(22) Per Federal Dwg 302-907	302-907	S-104	1
S-105	CHAMBER, Temperature; thermostatic; S.P.S.T.; operating temperature 60°C ± 2°C; 6.3 vac, 0.85 amp; metal case; 1-1/4" diam x 1-17/32" h excluding std octal base, heater connected to pins 3 & 7; plugs into std octal socket.	Crystal temperature control	40344	N16-C-95402-2247 (3Z9695-24) 3300-395247150	(27) TCO-1	SWH-1	S-105	1
			TRANSFORMERS					
T-101	TRANSFORMER, power: filament and plate type; input 115 v AC ± 10%, 50-1000 cycles, single phase, four output windings; secd # 1, 820 v at 70 ma CT, secd # 2, 6.3 v at 3.5A CT, secd # 3, 5 v at 2A, secd # 4, 12.6 v at .8A CT; hermetically sealed metal case, 3-5/8" lg x 3-1/2" wd x 4-3/4" h; 14 solder lug terminals on bottom; four # 10-32 x 7/16" lg mtg studs on 2-3/4" x 2-5/8" mtg/C; electrostatic shield between primary and secondary windings.	Power transformer			(15) Per Federal Dwg 309-904	309-904	T-101	1
			ELECTRON TUBES					
V-101	TUBE, electron: 6SJ7; RF pentode, sharp cut-off.	5 mc osc. 10 mc doubler	6SJ7	N16-T-56665 (2J6SJ7) 3300-234725000			V-101 V-102 V-104 V-106	4

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
V-102	Same as V-101.	20 mc doubler						
V-103	TUBE, electron: 12AT7; twin triode.	Detector-mixer	12AT7	N16-T-58240-10 (2J12AT7)			V-103	1
V-103A	TUBE, electron: 12AT7; part of V-103.	Detector						
V-103B	TUBE, electron: 12AT7; part of V-103	Mixer						
V-104	Same as V-101.	Audio amplifier						
V-105	TUBE, electron: 6SN7GT, twin triode.	Audio amplifier and output	6SN7GT	N16-T-56682 (2J6SN7) 3300-234754850			V-105	1
V-105A	TUBE, electron: part of V-105.	Audio amplifier						
V-105B	TUBE, electron: part of V-105.	Cathode follower						
V-106	Same as V-101.	Beat indicator						
V-107	TUBE, electron: 2C40; u.h.f. triode.	RF oscillator	2C40	N16-T-52340 (2J2C40) 3300-234190075			V-107	1
V-108	TUBE, electron: 5Y3-GT; full wave high vacuum rectifier.	Rectifier	5Y3-GT	N16-T-55735 (2J5Y3GT) 3370-234390000			V-108	1
V-109	TUBE, electron: OD3/VR-150.	Voltage regulator	OD3/VR-150	N16-T-53060 (2JOD3/VR-150) 3370-234006700			V-109 V-110	2
V-110	Same as V-109.	Voltage regulator						

			CABLE ASSEMBLIES					
*W-101	CABLE ASSEMBLY, power: Navy spec 15C1 type MHFF-2 cable, two #16 AWG stranded conductors, synthetic resin insulated, 600 v working, asbestos, inner fibre braid, binder, polychloroprene sheath, round 1/2" diam; 6'9" lg less term; Navy type 491077 connector one end, Navy type 49825 connector other end.	Power cable assembly			(5) 302-750	302-750	W-101	1
*W-101A	CABLE, power: portable; two #16 AWG conductors stranded; synthetic resin ins; asbestos, inner fibre braid, binder; polychloroprene; 600 v working, round 1/2" diam overall; Navy spec 15C1j.	Power cable	MHFF-2	15-C-10341-10 (1B3016-2.8) 8860-098960-8		CAB-2	W-101A	
			SOCKETS					
X-101	SOCKET, tube: 8 contact one piece saddle mtg two 1/8" diam mtg holes on 1-1/2" mtg/C mica-filled phenolic body; 1-13/16" diam, silver plated bronze wrap-around contacts.	Socket for V-101	491226	N16-S-63515-6641 (2Z8678.325) 8850-895950	(5) 9703-FM	SKT-6	X-101 X-102 X-104 X-105 X-106 X-107 X-108 X-109 X-110 X-111	10
X-102	Same as X-101.	Socket for V-102						
X-103	SOCKET, tube: 9 contact miniature; one-piece saddle mtg two 1/8" diam holes on 1-1/8" mtg/C mica filled phenolic body 7/8" diam x 3/8" h excluding terminals tinned brass contacts metal shock shield and center shield .099" inside diam; spec JAN-S-28A.	Socket for V-103	TSE9T101	N16-S-64063-6718 (2Z8679.30) 8850-896590	26	SKT-5	X-103	1
X-104	Same as X-101.	Socket for V-104						
X-105	Same as X-101.	Socket for V-105						
X-106	Same as X-101.	Socket for V-106						

* Not furnished as a maintenance part. If failure occurs do not request replacement unless the item cannot be repaired or fabricated.

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
X-107	Same as X-101.	Socket for V-107						
X-108	Same as X-101.	Socket for V-108						
X-109	Same as X-101.	Socket for V-109						
X-110	Same as X-101.	Socket for V-110						
X-111	Same as X-101.	Socket for S-105						
X-112	HOLDER ASSEMBLY: holder and mount for type 1N21B crystal; consists of symbol nos X-112A, X-112B, X-112C, X-112D, X-112E, and E-112F.	Holder and mount assembly for CR-101			(5) 302-330 less item 11	302-330 less item 11	X-112	1
X-112A	CAP: protective cap for crystal unit, rectifying CR-101; brass silver pltd; cylindrical; 5/8" diam x 5/8" lg overall; 5/8"-24 x 1/4" lg integral bushing for mounting.	Protective cap for CR-101		N16-C-145419-725 (2Z1619-64) 3300-286688700	(5) 302-355	302-355	X-112A	1
X-112B	HOLDER, crystal unit rectifying; holder and one contact for type IN21B crystal; brass silver pltd; cylindrical; 13/32" diam x .432" lg overall, 1/4-28 inside tap for non-integral phenolic rod.	Holder for CR-101		---------- (2Z6820.279) 3300-293353-560	(5) 302-331	302-331	X-112B	1
X-112C	ROD, locking: series type IN21B crystal to holder X-112B; bakelite; 1/4" diam x 11/16" lg overall; 1/4-28 x 7/32" lg integral thread for mounting; .086" diam hole drilled through rod on 13/64" x .140" mtg/C.	Series CR-101 to X-112B		N16-R-686201-101 (2Z8051-49) 3300-295551741	(5) 302-337	302-337	X-112C	1
* X-112D	BRACKET: for mounting crystal holder; brass; 2-1/8" lg x 15/16" wd x 1-1/4" h overall; four 0.1285" holes on 5/8" x 1-13/16" mtg/C for mounting.	Mounting bracket for X-112		N16-M-65720-7976 (2Z1244-101) 3300-286386677	(5) 302-250	302-250	X-112D	1

X-112E	CONTACT, crystal rectifier: brass; cylindrical; 1/2" diam x 9/32" h overall; two 1/16" wd x 1/16" deep slotted grooves; pressure mounts between two non-integral plates.	Contact for CR-101		N17-C-78880-2564 (2Z3191-284) 3300-287387851	(5) 302-335	302-335	X-112E	1
X-112F	INSULATOR, disk: round shape; clear India ruby mica; 9/16" diam x .002" tk; .312" ID center hole.	Dielectric for C-113		N17-I-77242-6021 (3G280-22) 3300-331-230021	(5) 302-334	302-334	X-112F	1
			QUARTZ CRYSTALS					
Y-101	CRYSTAL UNIT, quartz: Signal Corps type CR-18/U one plate, Signal Corps type HC-6/U holder, 5.0 megacycles; Signal Corps Spec. SCL-3059B, April 29, 1948; 2 pins spaced on bottom 1/2" c/c; solid pins 3/16" lg x .050" diam body 23/32" wd x 5/16" d x 3/4" h.	5 mc calibrating crystal		N16-C-97066-7001 (2X209-5000) 2100-2Z518-5000	(27) CR-18/U	CUQ-1	Y-101	1
			COMPOUND ASSEMBLIES					
Z-101	TUNER, waveguide: motivated by crank driven lead screw, revolutions indicated by mechanical counter (O-101); r.f. oscillator tube (V-107) and socket (X-107) integrally mounted at end of assembly; frequency range 500-1250 megacycles; 17-3/4" lg x 3-1/2" wd x 3-7/8" h; mounts by eight #8-32 screws into tapped holes in base plate.	Tunable RF oscillator cavity		N16-C-67620-1825 (3F34600-1) 3300-328554900	(5) 302-130	302-130	Z-101	1
Z-101A	CONTACT, electron tube: plate contact for V-107; brass silver pltd; 5/8" diam x 55/64" lg overall; slotted wiper type contacts; 7/16-32 inside thread for mounting; includes capacitor C-131.	Plate contact for V-107		N17-C-79435-3814 (2Z3193-118) 3300-287390425	(5) 302-190	302-190	Z-101A	1

* Not furnished as a maintenance part. If failure occurs do not request replacement unless the item cannot be repaired or fabricated.

TABLE 6-1. COMBINED PARTS AND REPAIR PARTS LIST—Continued

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY (SIGNAL CORPS) AND AAF STOCK NO's	MFGR. AND MFGR.'S DESIG.	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INV.	QTY. PER EQPT.
Z-101B	CONTACT, electron tube: cathode contact for V-107; beryllium copper silver pltd; round shape; 1-19/32" OD, 27/32" ID, 1/16" h; slotted finger like contacts; three .128" diam mtg holes spaced 120° apart.	Cathode contact for V-107		N17-C-79461-6068 (2Z3193-117) 3300-287390423	(5) 302-182	302-182	Z-101B	1
Z-101C	NUT, special: antibacklash nut for Z-101D; phosphor bronze; 1/4-28 left hand tap; 3/8" tk x 1-3/8" lg x 1.020" wd.	Antibacklash nut for Z-101D		N16-N-88601-1005 (6Z3804-28-17) 3300-651940300	(5) 302-257	302-257	Z-101C	1
Z-101D	FOLLOWER, screw: drives Z-101 wiper contact rods; cast bronze; irregular shape; 1-13/32" lg x 1-15/16" wd x 1-15/16" d overall; four 1/4" diam holes on 1-1/32" R spaced 90°, three 6-32 x 1/2" d holes on .687" R spaced 120°, one 1/4-48 center hole.	Drives Z-101 tuning contacts		N16-F-751001-101 (3F31305-1) 3300-328551050	(5) 302-242	302-242	Z-101D	1
Z-101E	SCREW, adjustment: steel; Z-101 tuning drive; tapped 5-1/4" lg x 1/4-48 left hand; 8-19/32" lg overall.	Transmits N-101 drive to Z-101D		N16-S-21226-1105 (6L4700.7) 3300-652153507	(5) 302-200	302-200	Z-101E	1
Z-102	FILTER, low-pass; cut-off frequency 100 megacycles; 2-5/16" x 1-21/32" x 1-11/16" O/A dimensions; aluminum case; two 0.144" diam mtg holes on 1-15/16" mtg/c; two solder lug term.	RF line filter		N16-F-44788-9501 (3Z1892-44.1) 3340-399858126	(5) 302-360	302-360	Z-102	1

			RECTIFIERS, CRYSTAL					
CR-101	CRYSTAL UNIT, rectifying: frequency 3000 megacycles, conversion loss 6.5 db maximum; silver plated brass, max diam 0.296" x 0.840" lg.	Detector	1N21B	N16-T-51721-10 (2J1N21B) 3300-234137020	(28) 1N21B	CUR-6	CR-101 CR-103	2
CR-102	RECTIFIER, metallic: selenium; input 12 Vac, 50-1600 cycles, output 6.3 vdc, 600 ma continuous; 1-13/64" wd x 1-13/64" h x 21/32" d excluding solder lug terminals; one 0.140" diam mtg hole through center.	Rectifier for V-103 and V-104 filaments		---------- (3H4860-132) 3300-375701556	(29) 2Q0675	RCM-2	CR-102	1
CR-103	Same as CR-101	Spare						
			SUB-ASSEMBLIES					
	DETECTOR ASSEMBLY: consists of probe disc assembly; holder for CR-101; socket and shield for V-103, C-112, C-113, C-114, L-104 resistor-capacitor board assembly with C-115, C-119, R-109, R-110, R-112, and R-113; silver pltd brass housing and cover; frequency range 100-10,000 megacycles; 3-1/4" lg x 2-3/8" wd x 2-1/2" h excluding shield; mounts by four #6 screws through clearance holes in bottom of housing.	Sub-assembly for V-103 and CR-101 circuits		N16-D-21228-1901 (3F4325-186B-2) ----------	(5) 302-290	302-290		1
	PROBE DISC ASSEMBLY: part of detector unit; consists of probe disc, probe, contact, tubing and terminal; 1-5/8" diam x 1-9/16" lg overall.	Terminates CR-101		N16-F-87401-1008 (3F4325-186B-1) 1690-329000232	(5) 302-340	302-340		1

TABLE 6–2. CROSS REFERENCE PARTS LIST

JAN DESIGNATION	KEY SYMBOL
CM20B471K	C–102
	C–104
	C–108
CM20C101J	C–103
CC26LH220J	C–105
	C–119
CM20C471J	C–106
	C–111
CM20C510J	C–107
CP54B5FF504X	C–109ABC
	C–123ABC
	C–124ABC
CC21LH150J	C–110
	C–121
CC21PH220J	C–112
CC21CK050D	C–114
CM20C511J	C–115
CM35B512J	C–122
	C–125
	C–126
	C–128, C–142
CP70B1EF405X	C–127
	C–139
CP54B1EB405K	C–129
CP53B1FF504X	C–130
CP70E1DF106X	C–140
CE31C102E	C–141
1N21B	CR–101
JJ034	J–102
MR25W001DCMA	M–101
RC20BF104K	R–101
	R–103
	R–114
RC20BF152K	R–102
RC20BF103K	R–104
	R–109
RC20BF393K	R–105
RC30BF823K	R–106
RC30BF472K	R–107
RC40BF472K	R–108
	R–134

JAN DESIGNATION	KEY SYMBOL
RC20BF474K	R–110
	R–120
RC20BF471K	R–111
	R–112
RU3B100K	R–113
RC20BF473K	R–115
	R–132
RC20BF681K	R–116
RC20BF475K	R–117
	R–128
RC40BF153K	R–118
	R–119
RC30BF683K	R–121
RC20BF274K	R–123
RC20BF222K	R–124
RC30BF332K	R–125
RC30BF271K	R–126
RC20BF105K	R–127
RC20BF332K	R–129
RC30BF224K	R–131
RC30BF222K	R–133
	R–135
	R–136
	R–137
RC20BF221K	R–138
RA20A2SA201AK	R–142
RC40BF184K	R–143
RW21D102	R–144
ST12D	S–101, S–103
ST22K	S–102
6SJ7	V–101
	V–102
	V–104
	V–106
12AT7	V–103
6SN7GT	V–105
TSE9T101	X–103

JAN DESIGNATION	KEY SYMBOL
2C40	V–107
5Y3–GT	V–108
OD3/VR–150	V–109
	V–110

NAVY TYPE NUMBER	KEY SYMBOL
–484741	C–101
–484493–D10	C–116
	C–117
	C–118
	C–120
–483330–10	C–132 thru C–138
–28032–2	F–101
–491822	H–101
–49496	H–102
–49194	J–101
–491108	J–103
–471253	L–101
	L–105
–471251	L–102
–471252	L–103
–472433	L–104
–472432	L–106
	L–107
–304918	L–108
–491077	P–101
–49825	P–102
–633786	R–139

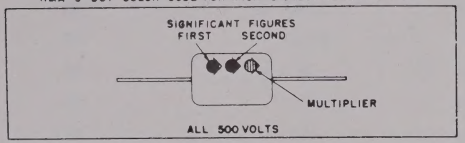
NAVY TYPE NUMBER	KEY SYMBOL
–637270–5	R–140
	R–141
–40344	S–105
–304919	T–101
–491226	X–101
	X–102
	X–104 thru X–111
–20660	CR–102

ARMY-NAVY NUMBER	KEY SYMBOL
CR–18/U	Y–101

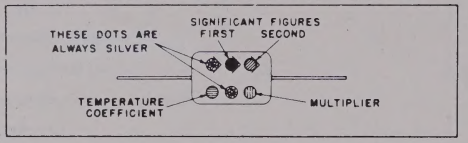
TABLE 6-3. APPLICABLE COLOR CODES

CAPACITOR COLOR CODES

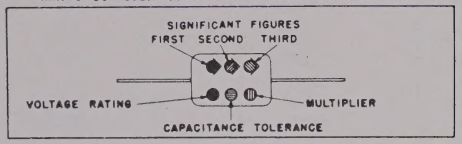
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



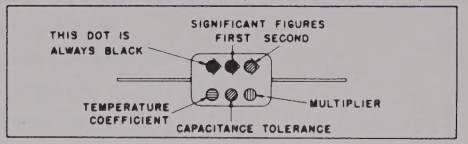
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



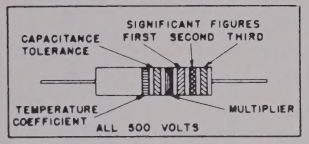
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

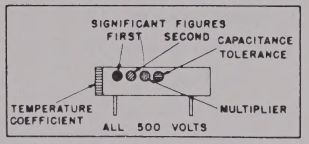


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

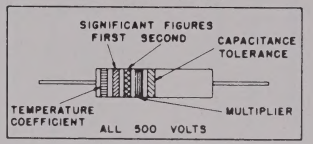


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



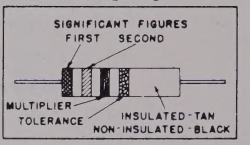
RMA - RADIO MANUFACTURES ASSOCIATION
JAN - JOINT ARMY - NAVY

RESISTORS				CAPACITORS				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	MULTIPLIER			VOLTAGE RATING	TEMPERATURE COEFFICIENT
				RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC		
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1,000	3	ORANGE	1,000	1000	1000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

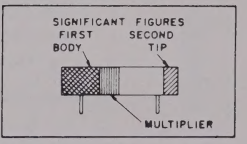
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

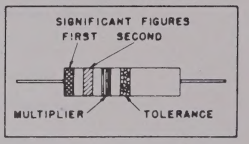


RADIAL TYPE



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED

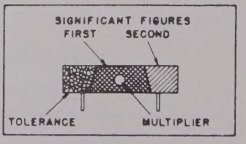


TABLE 6–4. LIST OF MANUFACTURERS

MFGR. NO.	PREFIX	NAME	ADDRESS
1	CFW	F. W. Sickles Co.	Springfield, Mass.
2	CAW	Aerovox Corporation	New Bedford, Mass.
3	CER	Erie Resistor Corporation	Erie, Pa.
4	CSL	Solar Mfg. Corporation	Bayonne, N. J.
5	CBVY	Telerad Manufacturing Corp.	New York, N. Y.
6	CSA	Stackpole Carbon Co.	St. Mary's, Pa.
7	CMA	P. R. Mallory Co., Inc.	Indianapolis, Ind.
8	CFA	Bussman Mfg. Co.	St. Louis, Mo.
9	CAYS	Drake Mfg. Co.	Chicago, Ill.
10	CAIS	Birtcher Corporation	Los Angeles, Calif.
11	CAYT	Allen Mfg. Co.	Hartford, Conn.
12	CG	General Electric Co.	Schenectady, N. Y.
13	CPH	American Phenolic Co.	Chicago, Ill.
14	CHU	Harvey Hubbell, Inc.	Bridgeport, Conn.
15	CFX	Freed Transformer Co.	New York, N. Y.
16	CASV	Veeder-Root, Inc.	Hartford, Conn.
17	CBZ	Allen-Bradley Co.	Milwaukee, Wis.
18	CIR	International Resistance Co.	Philadelphia, Pa.
19	CSF	Sprague Electric Co.	North Adams, Mass.
20	CTC	Chicago Telephone & Supply Co.	Elkhart, Ind.
21	CHH	Arrow, Hart & Hegeman Elect. Co.	Hartford, Conn.
22	COC	Oak Mfg. Co.	Chicago, Ill.
23	CRC	Radio Corporation of America	Harrison, N. J.
24	CW	Western Electric Co.	Kearney, N. J.
25	CBAK	United States Rubber Co.	New York, N. Y.
26	CMG	Cinch Mfg. Co.	Chicago, Ill.
27	CJQ	Bliley Mfg. Corp.	Erie, Pa.
28	CHS	Sylvania Electric Products, Inc.	Emporium, Pa.
29	CAFQ	Radio Receptor, Inc.	New York, N. Y.
30	CAUP	Kurz-Kasch, Inc.	Dayton, Ohio

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